

February 8, 1960

Aviation Week

and Space Technology

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**Lockheed Pushes
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At high altitudes

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The free world's fastest bomber, Convair's B-58, has penetration capabilities exceeding any other aircraft now in existence. At more than 50,000 feet or under 500 feet—it can do whatever the mission demands! It is now entering service with the U.S.A.F.

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FLIGHT HARDWARE...NOW

**VICKERS HOT GAS
AUXILIARY POWER SYSTEMS**
for missiles and spacecraft

CONCEPT

Vickers piston motors—as used in virtually all existing commercial and military aircraft—are now modified to operate efficiently on propellant-generated hot gas, or bleed gas from the main propulsion system. Minimum weight is achieved by mounting the hot gas motor "back-to-back" with a Vickers piston hydraulic pump in a common housing. The motor/pump is a single gas generator, hydraulic reservoir, filter, and relief valve are integrally mounted to form a complete Auxiliary Power System in a compact package.



DEVELOPMENT

Production line Vickers hydraulic motors have been operating on hot gas for over 2 years. Units have run as long as 100 hours at 2000°F without modification.

The present flight hardware was built and tested after an intensive prototype development effort. Test program motor/pumps have accumulated over 100 runs each for 1 minute of operation cycle. Since the current development program is aimed at meeting known APS requirements, no limits have been established on the operating cycle duration for this type of equipment.

CONCLUSIONS

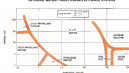
Performance and reliability goals for this concept have been met successfully. A complete hot gas APS package in the 2-8 horsepower range, shown above, is available within 90 days. Customer specifications for these and larger systems are invited. Write for Bulletin A-5243.

APPLICATIONS

Because of the increasing scope of APS applications, Vickers conducted a series of studies to establish criteria for APS selection. Recent study results published in March, 1960, indicate that for short duration operation, hot gas motors offer the best weight advantage in the 1 to 30 hp range. See curve below.

Attractive reliability and early delivery resulting from extensive use of proven hardware may extend the application of these systems to an even greater range of second and third generation missiles and spacecraft. Additional advantages include: low speed equipment (up to 10,000 rpm), convenient ground checkout, growth potential, and no start time required.

OPTIMUM WEIGHT HIGH-PROPULSION POWER SYSTEMS



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if you think this looks like CEC's 5-752...

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The picture shown here is of a new, improved version of the famous 5-752 Recorder/Transmitter. We call it Model 5-772A, and it represents the culmination of years of engineering time and practical experience.

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Pick a mode — say mode A-500, FM, PDM, CM, Signal. CEC's new 5-772A can handle any or all of them, with stereo capable Plug-In Amplifiers for live mode of recording or playback.

Monitoring versatility too.

The 5-772A features optional monitoring, either local or remote, of Signal Input/Output. Type head-coupled monitoring also.

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The cabinet is tougher than ever... all steel, all welded... all rigid, too, for such rough environments as audible or marine conditions. And a new, metal-formed, transparent cover (close daylight on a grid) and glass protection where it counts, over the tape and heads.



Specially designed CEC Current Amplifiers slide right into place... boost reproducible amplifier signal output... power all transmitters, chart recorder, and other allied instruments on the whole story, local and clear.

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CONSOLIDATED ELECTRODYNAMICS / precision... reliability

AVIATION CALENDAR

(Continued from page 5)

Symposium: Department of Commerce, Auditorium, Washington, D.C. Sponsor: Department of the Navy, Bureau of Naval Weapons.

Mar. 28-29—*Exposition of Radio Engineers' International Conference*, Waldorf Astoria and Congress, New York, N.Y.
Mar. 28-29—*Exposition on Optical Spectroscopy*, University of Chicago, Chicago, Ill. Sponsor: University of Chicago, Chicago, Ill. Sponsor: Laboratory, Intel-Ark Co., National Science Foundation.

Mar. 28-29—*First Annual Symposium on Human Factors in Electronics*, New York, N.Y. Sponsor: Institute of Radio Engineers' Professional Group on Human Factors in Electronics.

Apr. 4-6—*Fourth Colloquium, Constitution and Population Fund*, Advisory Group for Astronomical Research and Development, NYU, New York. Subject: High-Speed Number-Analysis, K. G. G. G.

Apr. 5-6—*1961 National Aerospace Meeting and Luncheon*, American Institute of Aeronautics and Astronautics, Long Beach, California. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—*1961 National Meeting "Hypo-Environments-Space Frontier"*, Institute of Environmental Sciences, Belmont Hotel, Los Angeles, Calif.

Apr. 12-13-14th Annual Spring Technical Conference, Institute of Radio Engineers in cooperation with the American Rocket Society, Hotel Elms, Cincinnati, Ohio.

Apr. 15-20—*International Symposium on Active Networks and Feedback Systems*, New York, N.Y. Sponsor: Polytechnic Institute of Brooklyn, Department of Defense Research Agency, Institute of Radio Engineers.

Apr. 20-22—*Natural Symposium on Natural Space Systems*, Institute of the Astronautical Sciences, Amesbury Hotel, Los Angeles, Calif. Cosponsor: NASA, the Royal Gage.

Apr. 21—*Natural Eastern Regional Meeting*, Institute of Navigation, Ki-Bu-Bu Hotel, New York, N.Y. Sponsor: D. G. G.

Apr. 21-22—*High-Speed Methods and Materials Conference*, "Vehicle and Materials for the Space Age," American Institute of Manufacturing and Production Engineers, National Hotel, Los Angeles.

Apr. 27-28—*Natural Meeting on Space Age Materials*, Committee Chapter of the American Society for Metals, Sheraton Hilton Hotel, Cincinnati, Ohio.

May 2-6—*National Association of Electronics Conference*, Electronic and Vacuum Tube Hatch, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

May 2-6—*South National Flight Test Symposium*, Instrument Society of America, San Diego, Calif.

May 9-11—*1961 Symposium of the Institute of Radio Engineers' Professional Group on Microelectronic Theory and Technology*, Hotel del Coronado, San Diego.



BENDIX FUEL NOZZLES MAKE COLD STARTING SURE

When pilots "scramble", there's no time to fool with cold start problems. That's why Bendix Fuel Nozzles are being specified on more and more jet engines—missiles and helicopters, too. Besides overcoming the cold start problem on the ground, these nozzles overcome in-flight starting difficulties after threats occur.

Bendix Fuel Nozzles are mass-produced out of long experience to give greater economy and dependable performance through advanced design and manufacturing processes. Today, they are used on engines powering aircraft all the way from the T-38 to the B-70.

Write for details on how Bendix Fuel Nozzles can solve your specific problem.

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Elmira Division, Bendix

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Circle 10 on Reader Service Card



FIRST TO MEET MS 21042 AND NAS 1291

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight



SPS FN-12 Series Featherweight locknut met the first in new MS 21042 calling for a lighter weight replacement for NAS 679 sheet metal nuts. New forged locknut offers major weight savings, superior performance, high reliability, also permits secondary weight reduction through use of external bolting flange.

Here is the only nut series that meets the new MS 21042 standard, calling for a lighter weight locknut that can successfully replace the heavier-type AN 263, MS 20394, MS 20802 and MS 21040 Series.

The new SPS FN-12 weighs as much as 60% less than NAS 679 sheet metal nuts and counterparts . . . up to 72% less than equivalent MS or AN types.*

The FN-12 saves weight in another way also. Because of its new configuration, it can be installed slower in vertical bulkheads than any other aircraft nut ever in use. This allows a narrower bolting flange, with consequent reduction in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 7 sizes—#4 through 3/8". All sizes are available for immediate delivery. From #4 to 1/2", FN-12 locknuts prove are practically the same as NAS 679 locknuts. In the 3/8" size, the price is considerably lower.

For more information, write SPS—manufacturers of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletin 2428.

NET WEIGHTS OF FN-12 AND EQUIVALENT LOCKNUTS						
All Weights Expressed as Pounds per 1000 Pieces						
Size	FN-12	NAS 679	Wt. Weight (based on FN-12)	AN 263	Wt. Weight (based on FN-12)	MS 20394
#4-4.40	0.4	0.6-1.6	60%-40%	1.4	40%	
#4-3.32	0.7	1.3-1.7	50%-40%	2.1	32%	
#4-3.30	1.0	1.1-1.5	40%-40%	4.2	20%	
#10-10.12	1.4	3.2-3.8	40%-40%	4.4	40%	
1/16-26	3.6	6.8-8.7	32%-40%	8.1	40%	
1/8-24	5.4	8.4-12.2	34%-32%	15.6	34%	
3/8-16	7.0	9.2	31%	19.3	30%	

*Based on the most commonly used sheet metal size of NAS 679 type. Design for AN 263 is 264.243.

MS 20394, MS 20395, MS 21042, NAS 1291, NAS 1032, AN 264, AN 264, AN 265 and AN 266 Blue.

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Cross section of coaxial line shows how Marmen's CONOSEAL joint seal seals joint to provide 100% metal-to-metal line seal.

Marmen's CONOSEAL Joint is designed to eliminate radio frequency leakage in coaxial lines. It features an all-metal gasket seal that seals line against its increased power. The CONOSEAL also provides a 60% weight savings over standard E.I.A. flanges and can be installed quickly, with minimum care and skill.

Available in standard styles and special couplings for electronic equipment, some versions of the CONOSEAL are designed to operate at temperatures from -300°F to +2000°F with pressures up to 20,000 psig. Marmen CONOSEAL joints are now used by Aerospace Electronics Division.

For full details on Marmen CONOSEAL Joints for electronic use, mail the coupon below.

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Explore all the advantages and application possibilities of Fenwal Thermoswitch Units. For illustrated booklet, write Fenwal Incorporated, 122 Pleasant Street, Andover, Massachusetts.



Another
example of how



CONTROLS TEMPERATURE... PRECISELY



more and more in
style for the men who
fly and maintain
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In National Defense **KAMAN** is part of the plan
THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONNECTICUT
PIONEERS IN TURBINE POWERED HELICOPTERS

Cold-Finishing of Alloy Steel Bars: Grinding and Polishing

Grinding and polishing of cold-drawn or turned alloy steel bars is the concluding discussion on the subject of cold-finishing. In the processes of turning and polishing, and grinding and polishing (both of which require removal of surface metal), the surface finish of the bars, as well as their dimensional accuracy and alignment, are improved. But the ultimate in quality of bright, smooth surface finish and accuracy is produced by grinding and polishing of either cold-drawn bars or turned bars up to 4-in. diam, inclusive.

GRINDING AND POLISHING

Sizes up to and including 4-in. diam, are generally confined to centerless cylindrical grinders. Larger sizes are ground on centers. A centerless grinder includes a grinding wheel, a regulating wheel for applying pressure against the bar, and a work-rest blade which both supports the bar and guides it between the wheel spacing. Automatic feed of the whole length of the bar is accomplished because the regulating wheel is set at an angle of inclination with respect to the grinding wheel, and thus within this system the bar rotates and feeds during grinding. The bar is then polished to a mirror-like finish by passing through straightening rolls.

Both processes of turning and polishing, and grinding and polishing, are applicable to normalized, annealed, or heat-treated carbon and alloy bars. These operations do not materially affect the mechanical properties. For this reason, the end product can be machined unsymmetrically, with little or no tendency to warp.

Fundamentals Only. In the past four advertisements, we have outlined basic fundamentals only on the cold-drawing of alloy bars, the effect of cold-drawing, turning and polishing, and grinding and polishing.

Please keep in mind that Bethlehem metallurgists have given long study to specifications with respect to chemical composition, grain size, hardenability, machinability, and the like, of cold-drawn alloy steel bars. If you would like additional information on cold-drawn products, or alloy steels, our metallurgists will gladly give you all possible help, without cost or obligation.

When you are ready for new supplies of alloy steels, Bethlehem can offer the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

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problems and compiling one of the world's most complete stores of systems knowledge, techniques, and components for obtaining accurate intelligence from the air. As a result, Hycon has become one of the nation's top suppliers of aerial reconnaissance systems to the U.S. Armed Forces and NATO countries. Please write for specific or general technical information.

Hycon Mfg. Company
1030 Arroyo Parkway, Pasadena, Cal
Specialists in research, development and production of aerial reconnaissance systems, automatic test systems, and communications systems.

How CAMCO achieves foolproof maintenance with Ansco X-ray films

General Anson and Marine Company, Sayville, Long Island, is Anson's largest independent retailer of Ansco industrial cameras. Inspecting a freight car's undercarriage took four hours by the old "visual" method and it was really an incomplete one that resulted in objections in both the Air Force and airlines.

Now CAMCO has switched to X-ray examination. Tests last time 9 minutes. Rate of rejection: zero.

Sara Ray Bonarman, "We've been using Ansco Industrial X-ray film for years. Other brands have been used but have failed us, provided the maintenance of speed, gradation and ease of readability, that we get from Ansco film."

CAMCO is just one example of the many operations depending on Ansco in critical non-destructive testing applications. Why not contact your local Ansco representative today for information. Ansco, Binghamton, N. Y., A Division of General Aniline & Film Corporation.

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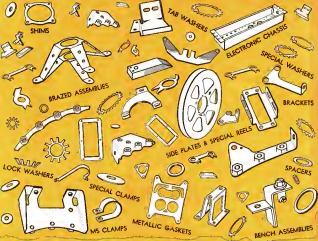


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Perspective on Safety

Senate hearings conducted by Sen. Monroney's subcommittee on aviation have provided a good perspective on the air safety problems facing civil aviation, particularly the air transport industry. One of the main considerations of the Senate group has been to explore the efficacy of the Federal Aviation Act which created the Federal Aviation Agency a little more than a year ago. It is certainly appropriate to review the operations of this agency to determine whether it has produced the results that this legislation was aimed at.

It is pretty clear from the testimony of most witnesses appearing before the Monroney subcommittee that, while there are many minor differences of opinion as to how the Federal Aviation Agency should function, there is a general agreement that the act has stood its initial test of time, and the FAA is moving down the right track.

Bigger criticism of FAA has been of the speed and all legal infirmities of its rule-making procedures. There has been an acute need for accelerating the protracted and often pointless debates that made the old rule-making process so ineffective and kept it so far behind the current operational problem of aviation. We can understand the feeling of urgency that has stimulated President R. "Pete" Quasada, the FAA administrator, to compress this rule-making rule. We can also sympathize with his reluctance of having to listen to the shrill and second-sound tenors of special interest groups who admit Washington and use the headliner they gun attacking FAA to impress the duck-eying members of their respective special groups.

However, it is apparent that whatever the validity and justice of its case, FAA would do well to provide for more informal and public discussion of its proposed rules rather than adhering strictly to the letter of administrative procedure. It is also evident that, while "Pete" Quasada needed to throw the book at violators of air safety regulations without fear or favor to establish the fact that he meant business, some of his subordinates have named this critical beyond reasonable grounds in some instances and have descended to a 'nit picking' and overlegalistic approach to safety enforcement.

There can be no sympathy from the public or air transport industry for the type pilot behavior cited by "Pete" Quasada in his testimony before Sen. Monroney's group. FAA must continue to prosecute this type of irresponsible, willful violation with all the vigor at its command. The Air Line Pilots Assn. and other pilot groups must support this type of safety enforcement or lose their effectiveness as legitimate spokesmen for the majority of pilots who have a most sincere interest and the biggest stake in safety enhancement.

Nobody believes that pilots who slept with their feet on the radar, banned FAA inspectors from the cockpit or flew into a maintenance in broad daylight are typical of the majority of airline pilots. But they are typical of an irresponsible minority who must be culled from the

air by concerted action, beginning with company qualification programs and supported by FAA as a last resort.

Airline pilot management too must devote considerably more attention to its safety problems and provide more support for its operations' people in their clashes with controllers over the admittedly high cost of many safety contributions. FAA safety regulations are aimed at preventing minimum standards, and some airlines have been consistently ahead of FAA in adopting new safety devices, such as airborne radar, and in exceeding FAA requirements in such areas as cockpit qualification and the retirement of obsolete equipment. Airlines operations personnel have been more safety conscious of safety problems as they arise and are vigorous in their attack on them. But all too often, they tell stories of achieving their goals because of top management indifference or misinterpretation.

Airlines will find their malfunctions involving less FAA violation unless if they do an increasingly better job of policing their own backyards. Virtually everybody testing before Sen. Monroney's group agreed on the major involved safety problems facing aviation in traffic control and instrument flight. As we have pointed out so often, the current FAA leadership cannot be held accountable for this disjunctable lag in developing, financing and installing a modern electronic navigation and traffic control system and high intensity lights. This is the area that needs concerted effort by all elements of aviation, including Sen. Monroney's group and their legislative colleagues in both the House and Senate.

This is the area where, without effective action today, the safety problems of tomorrow are certain to be compounded. We are getting a little impatient with the unaccountable criticism of FAA Administrator Quasada as a "see man show" and "dictator." For it is in this vital area of trying to make up for the precious time lost by a series of "nominal" CAA administrators, who finished and bungled these vital programs, that the first year of the FAA can represent the vigorous drive deployed by "Pete" Quasada to overcome the inertia of the broad-based bureaucracy.

We earnestly hope he can utilize more of his vigor into the lower tiers of FAA leadership that he will leave behind him when he retires. There is little profit for anybody in the aviation business in continuing the special interest rump that has muddled the Washington aviation scene in recent years. Real safety achievement does not come from regulations or legal proceedings. They can be achieved only by a genuine spirit aimed at top notch performance all down the line.

The immediate problem is to push modernization of navigation, traffic control and airport facilities as fast as possible and to develop an effective industry-government relationship that will keep pushing toward this goal long after the current FAA leadership has retired.

—Robert Huts

B.F. Goodrich

New electrical prop De-Icers now FAA approved for Beech 95 Travelair

FAA approval, STC No. 83J-412, has now been granted for the new B.F. Goodrich Electrical Propeller De-Icing System on the Beech 95. This is the first in a series later to include the Aero Commander, Cessna 310, Piper Apache, Beechcraft D & E-18, and Twin Otter.

Simple De-Icing—Control body is 11 inches in length through the de-icer automatically for maximum efficiency at power and effective de-icing. The system is similar to those proved through years of use by airlines and the military—no ice protection in freezing weather.

Easy Installation—Complete kit is available, weighs only 8 to 10 pounds. BFG Electrical De-Icing eliminates tanks, valves, hoses, excess weight and complex electrical.

Ask your B.F. Goodrich Aviation Products Distributor for information on complete ice protection for business aircraft. B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Dept. AF-22, Akron, Ohio.

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B.F. Goodrich aviation products



Illustrated: 40 Pound Thrust Motor Assembly
(see text and photo)

1. Thrust Motor, 2. Thrust Motor Assembly,
3. Thrust Motor Assembly, 4. Thrust Motor Assembly,
5. Thrust Motor Assembly, 6. Thrust Motor Assembly

REACTION CONTROL SYSTEMS BY KIDDE are highly reliable, now in production. Today being used on the NASA Scout, Air Force Thor, and the Air Force HETS, they are low in cost, light in weight, highest in performance. Kidde systems use mono-propellant, bi-propellant, cold gas, or solid fuels. Thrust motors from 2 to 600 pounds. For repeatability, response, and reliability in reaction control equipment, Kidde can serve you best! Write to Kidde today outlining your reaction control requirements.



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WHO'S WHERE

In the Front Office

Chad Sloan, formerly with Boeing Aerospace Co., is now executive vice president general manager of Texaco Aircraft Corp., Dallas, Tex.

Gay B. Estabrook, president and a director, Communications Accessories Co., Long Beach, Calif., is a director of Collins Radio Co. Estabrook recently elected J. Gernsey who continues as a director.

Alfred H. Nodding, vice president executive planning, General Electric, Inc., Frederick R. Burdette, vice president finance, Chrysler-Vought Aircraft, Inc., Dallas, Tex.

Charles S. Boudier, assistant to the president corporate planning and development, Douglas Aircraft Company, Inc., Santa Monica, Calif.

Alfred H. Nodding, vice president, Northrup Aircraft, Inc., Santa Monica, Calif.

Robert F. Gaudin, president Aircraft Division, Inc., Los Angeles, Calif., is now president of General Electric Aircraft Division, Inc., Los Angeles, Calif.

Dr. Robert W. Gaudin, a director, the chief executive officer, Westinghouse, Del. Dr. Gaudin is director of research in the field of aircraft engine development.

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INDUSTRY OBSERVER

General Electric is working toward development of a controllable nose cone for the Air Force-Convair Altus intercontinental ballistic missile to give it the capability of changing its flight path from a straight ballistic trajectory and complete the task of anti-ICBM defense. Soviet Union is believed to be working on a similar vehicle.

Flight test program for the General Electric J91 turbojet program for North American Aviation's Mach 3 B-70 bomber has been temporarily delayed, although a Convair B-36 with an underbody pod structure designed for testing the engine is available at Edwards AFB, Calif. USAF then has been asked to schedule funds to permit the engine test and conduct the flight test program as originally planned. One engine will be tested this year in the late altitude wind tunnel at Arnold Air Development Center but not at the facility's high altitude and high Mach number wind tunnel.

Defense Department is investigating half a dozen techniques for detecting the burning of infrared missiles which make use of electromagnetic energy reflected off the atmosphere in which the missiles are fired. Naval Research developed Project Tanager (NAV Aug. 17, p. 13). Although the new detection techniques are not expected to be as reliable as the Bellini-Missile Early Warning System (BMEWS), they would require only a few extra channels of equipment, easily installed facilities. The techniques are viewed as supplementary, not competitive, to BMEWS and Project Mantis early warning systems.

Advanced Research Projects Agency has dropped its Project Tangle countermeasures intelligence program, an instantaneous reporter type that was intended to test automatic system components to be used later in Project Dement, a 34th, however, countermeasures satellite. AFPA is continuing the program, the delayed reporter communications satellite under development by the Army Signal Corps, and Project Star, an instantaneous-reporter type polar-orbiting satellite being developed by Air Force for use by Strategic Air Command.

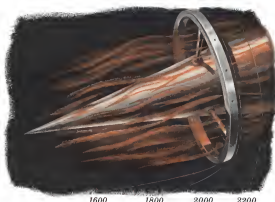
Air Force within the next few weeks will submit an experimental operational program to improve North American B-70's on-air-launch launchers to determine the feasibility of adopting the plan on a wider scale (NAV Nov. 9, p. 107). Most of the directed aircraft under the experimental program will come from Tactical Air Command units stationed at the T-10 Base.

Air Force has installed prototype equipment for its Mideast early warning satellite in an attempt to check its ability to monitor and follow the trajectory of U.S. missile test launches.

Hydrocarbon-oxygenated dimethyl hydrazine fuel research and storage technology research is now considered to be the most likely high energy, storable propellant combination for use with Martin's Titan ICBM (NAV Feb. 1, p. 24). Specific analysis of this combination—775 sec—propellant will be used to specify the weight of the present Titan ICBM of 17,000 lbs. of liquid oxygen and RP-1, while its density is 17.7 lbs./cu. in. is an increase higher than the 17.6 lbs./cu. in. of liquid oxygen RP-1.

Weight Air Development Division will soon call for bid proposals for a cryogenic storage, with draft rates in the order of 9,000 deg. per hour, for use on missile launchers (NAV Feb. 1, p. 71). Approximately a dozen companies engaged in cryogenic and/or cryogenic work attached recent WADD pre-bid briefing conducted in Dayton.

Mechanics Staff of Japan's National Defense Agency is drafting a 10-year program looking toward limited production of a Japanese-designed supersonic anti-submarine patrol. Part of the second, designed to replace the Lockheed P-3 and Grumman S-2F now used by Japan for ASW patrol work, is scheduled to be produced in 1967. Third aircraft planned under the program is 26 by 1970.



Cutting back the Thermal Thicket

The great strength and high scaling resistance of Haynes alloys at temperatures of 2000+ deg. F. are providing long service life in the hottest areas of jet engines. In these hot spots where the properties of Haynes high temperature alloys are helping combat burnout, erosion, and stress in the jet, turbine, nozzle, and rocket fields.

There are twelve Haynes high-temperature alloys to choose from, formulated to handle virtually any heat condition. Among them: HAYNES alloy X with remarkable resistance to oxidation up to 2500 deg. F.; HAYNES alloy No. 25 that resists stresses, oxidation, and carburization up to 2000 deg. F.; and HAYNES alloy K 838, outstanding in the 1500 to 1750 deg. F. range. All are readily available.

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Martin Titan Management

Air Force is still not satisfied with Martin Co.'s management of the Titan program and is not completely convinced that Martin Chairman George M. Butler's move to Denver to take over the program will solve the problem. USAF feels the company should strengthen its management structure with additional executive talent and that there is still a need for Air Force supervision of the way Martin runs the Titan program. Some thought has been given within USAF to possible financial penalties to recover any losses from Martin shortcomings in the program.

Banker took personal charge of the Titan program last month and merged Titan operations of the Denver Division, Aerospace Division and Space Division into a single, integrated division based in Denver (AW Int'l, p. 18). Just before Banker took over as general manager of the Titan program, Air Force Ballistic Missile Division and Space Technology Laboratories also placed a management survey of the program, and changes were recommended.

Symington's Pentagon Plan

Reorganization plan for the U. S. military structure proposed by Sec. Stuart Symington (D-Mo.) last week would impose a centralized management pattern on the Defense Department without retreating the individual services. Under Symington's plan, the services would continue to handle administrative functions, and the President would continue to conduct research for defense, strategy, operations, logistics and other purposes. Defense secretary would have the power to transfer personnel from one service to another.

Chief of Staff of Defense would be named under the Symington plan to head the Joint Chiefs of Staff with power of Staff Director over all matters coming before the JCS. Chief of Staff of Defense would be responsible for preparing a single over-all war plan for all the services and for assigning tasks to the services under that plan. He also would receive major personnel and military assignments of the services in light of the war plan and set policy for joint training of the armed forces.

Eisenhower on the Space Race

President Eisenhower continued to stress that the U. S. is in a technological space race with the Soviet Union last week. At the same time, the Administration was asking Congress for increased funds to hasten progress on the space program which represents the nation's only real source of progress for improving Russian administration.

Asked at his news conference about the situation for U. S. Information Agency chief George Allen that U. S. prestige abroad has suffered from Soviet space successes (see p. 61), Eisenhower noted that he had recently returned home a lengthy trip which included the nation's prestige is high consequently. Concluding that the country needs to move ahead in space in every other field, the President concluded that.

"The reason for going into space, except for those activities that are carried on by the Defense Department in having some value to the security of the nation, is purely scientific. Therefore, you are not talking about racing there or finding the perimeter there as it is outside the particular case that you are going to run on the

race, you work out a proper and an appropriate plan of scientific exploration, and you follow it positively, rather than trying to follow some behind somebody else."

"Now, it is not hard time and again that because the Soviets are far ahead in this very large launchers and engines, that, so far in distant space, exploration is concerned, they are going to be ahead in that regard for some time, because it takes time to get that engine built."

"Now, just taking it over, the Saturn project from the Army, I have, after a long study by the space agency—have determined that the amount of money that we took over with that particular thing was not sufficient, and that's another hundred million being devoted, or at least recommended by devotees to it. I believe it will be appropriated, and I believe that—again, not only the administration of the United States is to go ahead rapidly with this thing, I believe that we can look forward at the proper time to success."

... And Another View

In the same vein, Dr. George B. Kistiakowsky, the President's scientific adviser, recently told a meeting of the American Physical Society that the U. S. "cannot ignore the very real political implications of various (Soviet) spectacular accomplishments in outer space that have come to have symbolic meaning to the world at large."

Dr. Kistiakowsky said it is unfortunate that technological spectacles tend to be viewed by the public and the press as the sole measure of scientific and technological progress and thus of military power. He said the U. S. scientific achievement in space has already matched those of the Soviet Union, notwithstanding the greater publicity given to the Soviet "technological spectacles." He also said the U. S. should not accept a secondary role in future outer space activities requiring huge rocket launches, but added that "we must accept the technical reality that power is a vague notion... there are limits on how quickly the gap can be closed, and these limits are largely set by technological factors."

Nuclear Weapons for Allies?

The President also hinted last week that he favors transfer of some nuclear weapons capability to nations allied with the U. S. He said, however, he would not divulge nuclear information which the Soviet Union does not already have but that, when the Soviets have the information and know-how, "it's pretty hard for me to understand why we don't do something with our allies, as long as they themselves stand with us firmly in defending against the probable aggressive intent of communism."

Justice Studies Votral Merger

Justice Department is studying the proposed merger between Boeing Airplane Co. and Votral Aircraft Corp. to determine whether it would violate the anti-trust provisions of the Clayton act. Under the proposed merger, Boeing would move into the short haul and commuter market by acquiring Votral and operating it as a division. The merger would be accomplished through an exchange of two shares Boeing stock for each share of Votral stock.

—Washington staff

NASA Plans Two Launches a Month Over

By Fred Eastman

Washington—National Aeronautics and Space Administration plans to launch an average of two major space vehicles a month for the next 10 years. Associate Administrator Richard E. Hottel told the House Committee on Science and Astronautics that the mean rate of major flights scheduled for the last half of Fiscal 1962 through Fiscal 1969 totals approximately 700. Missions will range from test firing of boosters and upper stages to deep space scientific probes and manned flight around the earth and moon (AWT-1, p. 34).

Hottel also told the committee, headed by Rep. Charles Bonior (D-La.) that in Fiscal 1962 and beyond the present variety of flight-launch vehicles will be reduced to one solid-propellant rocket, the Scout, and one liquid-propellant rocket, the Thor-Able and Saturn.

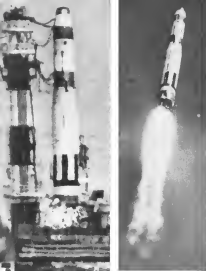
He said NASA also must eliminate the Thor-Atlas combination, leaving only the Scout, Atlas and Saturn in first stage vehicles.

Development Testing

The 7 SeaStar B-3 Thor/F-1 engine testing development by North American Aviation's Rocketdyne Division is not scheduled to begin development testing until 1968 and is not expected to become operational until some time after that.

Restoring the number of vehicle types will reduce the cost of the program, Hottel said, and increase the so-

NASA's Anticipated Major Vehicle Launches												
Vehicle	1960 (Actual)	1961 (Forecast)	Fiscal Year									
	60	61	62	63	64	65	66	67	68	69	70	71
Atlas	2	2	2	2	2	2	2	2	2	2	2	2
Able	1	2	1	2	1	2	1	2	1	2	1	2
Atlas II	0	0	0	0	0	0	0	0	0	0	0	0
Thor-Able	0	1	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Thor	0	1	0	0	0	0	0	0	0	0	0	0
Thor-Able	0	2	0	0	0	0	0	0	0	0	0	0
Thor-Able	0	1	1	1	1	1	1	1	1	1	1	1
Thor-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
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Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able II	0	0	0	0	0	0	0	0	0	0	0	0
Atlas-Able	0	0	0	0	0	0	0	0	0			



Second Stage Ignition Tested in Titan Flight

Cape Canaveral, Fla.—An F-15 Falcon-X made its first flight in four months last week, successfully testing both its crosswind guidance system and system of its 58,000 lb. thrust second stage engine for the first time. Two earlier attempts to test second stage propulsion failed when the missiles exploded at launch.

Another test flight was scheduled for the end of last week and the first attempt to recover an instrument package, ejected from the nose cone, was to be made.

Titus B7A was launched from USAF Minuteman Test Center's Pad 39 at 1:40 p.m. PST on Feb. 2. Separation of the 41-in., 48,000-lb. second stage and ignition of the Aerojet General engine occurred about 124 sec. later. This is the largest U. S. engine to be ignited at altitude.

The mainline traveled approximately 2,200 mi. Continued guidance notes developed by Bell Telephone Laboratories and Rensselaer Polytechnic Institute, carried in the second stage, apparently guided it with great accuracy. The guidance system has been earned on earlier short-haul runs not coupled to the coastal system.

The Bell-Ramington Road system will be used in each Titus squadron and some satellite and spot probe projects. Later Titus squadrons will use an differential system being produced in AC Spot Plug and International Road and Machine Corp. to a design developed by Massachusetts Institute of Technology's Instrumentation Laboratory.

The F-16s that won the only B-model that will be fired. Both a B and a have exploded on their launching pad near the base. Most of the test stage tests for the B series were achieved in last week's shot, and the remaining objectives will be incorporated in the next (the C-model).

Cummins will concentrate on shaping alternate source performance of the second stage engine and other systems used on propeller-driven turbos. The C Model carries an airframe-mounted fueling over an Aero re-entry body. When the C-3 exploded on Dec. 12 (AWD Dec. 21, p. 19), the recovery unit in the nose cone performed its entire program as the missile burst in the god, extending its drag parachute, ejection its fire master and shark repellent and hoisting its beacon radio antenna.

Another test launch was aborted in late January (AW Feb. 1, p. 27). A sequencer detected an overtemp in a turbine fuel pump and first stage nozzles were shut off on the pad.



Space Technology

Navy Using Moon As Reflector For Operational Radio Service

Chattanooga, Md.—Moggs is now serving as a patient communications coordinator for Navy operations and radio teletype and facsimile service between Washington and Hawaii.

Navy also is believed to be planning to use the moon as a simple navigation satellite for submarines and surface vessels which can take a radio signal on signals reflected off the moon's surface through use of a radio antenna or direction finder.

Equipment presently installed here at the Navy communications center near Washington provides four two-way radio systems, distinct or one radio for

simultaneous. Nave is using a frequency of 435 to 445 mc in the UHF band at present but plans to move into the microwave band to obtain greater bandwidths and permit the use of smaller antennas for ship-to-shore and ship-to-ship communications via coast highways. Additional bandwidth also will provide several more channels and perhaps television circuits.

All three military services have, as are experimenting with moon house communications, but the Navy is the first to put a system into operational use, although the present facility is still officially classed as an experimental station.

The moon can be used to relay signals between any two points which are neither side view of its surface. Washington and Moscow can both view the moon for periods ranging from several hours to up to 12 hr, depending upon the moon's orbital position, with the first occurring about 8 hr.

High-Score Spot Interference

Since the system operates in the UHF band, it is not vulnerable to sun spot or other atmospheric disturbances which can block out high frequency (HF) radio signals, and for long-distance communications. The present system was put into operation last by the Navy last November when normal HF communications were disrupted by *anomalous conditions*.

With the shift to higher frequencies and the use of constant or parametric amplifiers to increase receiver sensitivity it should be possible to obtain more

horizontal omnidirectional using moderately
size antennas. Present system used four
0.4-ft diameter antennas made by D. S.
Kinnick, two of them in Hanna, two
in Washington. One at each location
is used for transmission, the other for

reception. The entrance set is available so that they can contain almost any

the reason despite its numerous and
early visitors.

Thomson UHF transmitters have an output of 100 kw., but the antenna gain produces an effective radiated power of 490 mw., according to the Navy. Present orders were dropped and cancelled by Developmental Engineering Corp. of Lombard, Va. Total system cost is approximately \$4 million. Other major subcontractors in addition to D & K include Conventional Manufacturing Electronics Co., East-McClough, General Electric Corp., H&T Laboratories and Science Communications, Inc.

Percent System

The packet system provides a bandwidth of 16 kb, employs frequency shift keying for both teleprinter and facsimile, with 79 kb shifts. Frequency division also is employed at 25 kb steps to a maximum of 100 kb.

Lockheed Diversifies to Solids

Berkeley, Calif.—Lockheed Aircraft Corp. announced plans last week to acquire a 50% interest in Great Central Rubber Co., of Redlands, Calif., in the latest in a series of moves toward broader diversification.

Under the plan, Grand Central will be jointly owned by Lockhead and Pinta/Inc Chemical Corp., a wholly-owned subsidiary of Food Machinery & Chemical Corp. and Transamerica Gas Transmission Co. The Lockhead investment and Grand Central will retain its name, corporate identity and management personnel.

Founded in 1955, General Control became a subsidiary of Petro-Tex in 1968 and has a current annual sales volume of approximately \$18 million. Current work includes development of a high-thrust rocket propellant for Aero's Nike Zeus air interceptors and ballistic missile and an engine nozzle for National Aeronautics and Space Administration's Project Mercury space program.

Lockheed's Interests

Lockhead's interests will be guided by L. Eugene Root, the firm's group vice president for corporate electronics and weapons liaison.

Grand Central will continue to contribute an added professional development

conventional HF teletype during developable reactions

In the next public demonstration, the Navy transmitted two-way teletype messages between Chelofishov and Hiram and a thousand photo from Hiram to Chelofishov. In addition, a message transmitted from Chelofishov was bounced off the moon, returned in Hiram, and re-transmitted via the moon back to Chelofishov, with the signal covering a total (two) distance of close to one million miles.

First Experiments

Arriv was first to conduct experiments in bouncing radio signals off the moon in 1946. In June, 1954, MIT's Research Laboratory successfully passed the first continuous wave signals over a moon reflection path and two months later bounced the first voice signals off the lunar surface.

In February, 1918, the Chief of Naval Operations directed the establishment of a season cruise vessel between Washington and Pearl Harbor to evaluate its capabilities and limitations. The contract for the present system was awarded three months later to Diversified Engineering Corp. Current experiments include sonic transmission tests (AW May 12, 1918, p. 32, Aug. 15, 1918, p. 15).

ments, working closely with the Lockheed Martin and Space Division. The group, however, is not expected to affect Lockheed's present relationship with Airbus General Corp. in development of the subsonic-jet propulsion system for the Next Lockheed P-51 for ballistic missile.

Lockheed touched off its latest round of disqualification seven days last week with the formation of an affiliated company, Lockheed Associates, in Mexico City for production of the Model 68 two-passenger ultralight aircraft and purchase of controlling interest in the Papet Sound Hedges and Dredging Co., at Seattle (AW Apr. 6, p. 37). Papet Sound last month acquired its first large contract when winning under Lockheed contract—a \$500,000 order from the University of California for construction of an oceanographic survey vessel.

In May, Lockheed acquired Steward Engineering, Inc., which, in December, was merged with the parent firm's Electronics and Avionics Division for the formation of Lockheed Electronics Co. (AW Dec 14, p. 35). Later in December, Lockheed Aircraft International announced that it had acquired a major stock interest in Aeromaster, Inc., of Venice, Italy, and learned the firm to build the Model 60.

Zeus Delayed by Technical Doubt, Budget

By Philip J. Klein

Washington—Administration decision to withhold \$337 million in Fiscal 1960 funds originally appropriated for the joint production effort on Arco's Nike Zeus anti-ICBM missile is not likely to delay seriously for an additional billion dollars in Fiscal 1961 for Zeus production. The group of scientists headed by Dr. George Khachatryan, the President's scientific adviser, and Dr. H. B. Sticker, assistant director of defense research and engineering, fear no defense made the most comprehensive analysis yet performed on a weapon system, according to one Defense official. He adds that he doubts whether some of the weapons now in the inventory would ever have gone into production if they had been subjected to the same intensive scrutiny as the development stage.

During an intensive look-through at missile defense technology, the group felt the nation's sole defense against ballistic missile attack for at least several years in the early and mid-1960s will be the threat of nuclear retaliation. That was acknowledged by Defense Secretary Thomas S. Gates during recent House appropriations hearings (AW Jan. 25, p. 11).

The Administration decision is based upon both financial and technical concerns and follows the recommendations of the Joint Chiefs of Staff and a special group of top scientists that made an extensive appraisal of the Zeus (AW Nov. 2, p. 1).

The President's budget message and the Nike Zeus "can not be placed in production during the coming year during which further testing will be carried out," the system should be ready to test before production is begun and facilities are constructed for its deployment.

Basic Questions Remain

The missile be involved in capturing that is decision as to whether to put Zeus into production. There is deep skepticism on the results of forthcoming tests in the Pacific. Most qualified observers, however, seriously doubt that the Zeus team now planned could improve basic quality that exist on a qualitative, or on some smaller scale, can provide a practical and effective national defense against ballistic missiles. Highly successful tests, however, might greatly influence opinion to produce a few Zeus interceptors for defense of a limited number of vital areas.

The group of scientists who spent many months in studying Nike Zeus based their appraisal on the design questions and uncertainties present the reasons for which it is being delayed.

There is no serious doubt that Nike Zeus can be built with large available stock of air.

The last question to which the scientists and the Joint Chiefs addressed themselves is whether a Zeus-type anti-ICBM missile system can be sufficiently effective to justify an expenditure of \$15 billion in perhaps more. That is the estimated cost to protect vital target areas and equip other.

The group of scientists headed by Dr. George Khachatryan, the President's scientific adviser, and Dr. H. B. Sticker, assistant director of defense research and engineering, fear no defense made the most comprehensive analysis yet performed on a weapon system, according to one Defense official. He adds that he doubts whether some of the weapons now in the inventory would ever have gone into production if they had been subjected to the same intensive scrutiny as the development stage.

Deferred Decisions

Some of those who question whether foregoing Nike Zeus tests will provide any new data of significance believe the current decision is intended as an interim action to keep the program going until a new Administration comes in and can take the difficult decision of either stopping the program or providing funds for production and development.

Unless the new Administration decides to increase the defense budget by at least several billion dollars, some Defense Department observers doubt that Nike Zeus will ever see more than token production, if that. This does not mean that Zeus stock will require several billion dollars in the Fiscal 1962 budget but that it is not complete for any production means with after wrap out, possibly those that will increase the nation's arbitrary strength or make

existing weapons less valuable to the group which.

In an election year, congressional critics are expected to level their fire on what some observers see as a major incoherence in the Administration's air defense policy as expressed in the current budget.

Defense Department officials in open partition language has pointed out a Russian's generally technological superiority in ballistic missiles during the next several years by pointing to United States superiority in missile capable of delivering nuclear weapons.

Present Defense Posture

Despite the threat of U. S. superiority in nuclear weapons during the next several years, the Administration is not taking an air defense posture solely on exclusively defense but it is taking for more than a half-billion dollars in Fiscal 1962 with a half-billion dollars in Fiscal 1963 and Nike Hercules air defense missiles and another several hundred million dollars for expansion of the SAGE aircraft early warning system.

Yet five years from now, when ballistic missiles will probably outnumber the Soviets and have the larger arsenal, the Administration will be relying almost entirely upon retaliation defense, or no defense, in 1968 or even if it were changed because it is an unwilling to increase federal expenditures by less than 2%, the amount needed now for Zeus production effort.

These critics are expected to ask whether the several billion dollars in capital costs are justified by the need for completion of no defense against nuclear weapons in Fiscal 1961-62 might not be better spent for Nike Zeus tests.

Not least since Defense Department question there are expenditures over the weeks of continuing to spend these additional funds for defense against national foes. However, it is possible that the Soviets will present a dangerous, head-on threat and that relatively little money could be used by maintaining Boeing or SAGE projects and present programs for Hercules replacements at this late date.

Even if it were decided to terminate these programs, some Defense officials believe the funds saved could buy a more effective defense against ballistic missile attack if used to expand production of our own ballistic missiles, improve the handling and delivery of our missile units, provide mobile launching platforms or more Polaris fleet ballistic missile submarines.

In an age of ballistic missiles, nations must face the fact that there is no less



Drawing Shows B-52H Configuration

Boeing Airplane Co. artist's conception of a B-52H shows the missile platform armed with two North American Blood Dog missiles. First B-52H will not only test but also carry out the mission. Arco is designed to strike three targets thousands of miles apart on single mission.

ballistic missile defense known to states at present, only the passive defense of retaliatory deterrence, these observers believe.

Any defense system can be overwhelmed if any enemy builds and launches sufficient numbers of attacks on the system. In the case of the national defense, it is not a considerably more than that of the Soviet or Nike Hercules required to knock it down, giving the defender an economic advantage. But for a ballistic missile, which can carry a number of low-cost boosters, each of which may require as much ICBM waste to launch it down it cannot be quickly attacked at a defense, the defender from an economic standpoint. Even without boosters, Zeus system are the cost of building Nike Zeus missiles plus the required ground launch and computer can face the defender to spend something near a dollar for every dollar in enemy spend in building ballistic missiles.

Worried as this fact, Nike Zeus cannot provide a real defense against enemy ballistic missiles, with a mechanism which leaves an enemy to build additional missiles, according to Zeus critics.

The same could be achieved at less cost by putting money that would be needed for Zeus implementation into the development of more U. S. ballistic missiles, additional launching and disposal of missile units, mobile launching platforms and other new Polaris submarines, some Defense officials believe.

In this argument, Zeus supporters point out that the accuracy may be obtained by U. S. ballistic missiles and those apparently being obtained by the

Soviets, make launching less and less effective in protecting our own retaliatory capability and other vital targets. It is only a matter of several years before both the Soviet and the U. S. will have ballistic missiles capable of hitting within a radius of less than a mile of the intended target point, observers believe.

With early reaction, three-nuclear warheads, each warhead will launch out into the air and be launched from a submarine launch to cover several hundred pounds per square inch, these observers contend.

Unless some active defense system such as Nike Zeus is installed to provide a measure of protection for solid missile command and control centers, there might be an action with the authority to direct the nation's counterforce or its nuclear war effort.

At best a few Defense officials have begun to think of the possible desirability of Nike Zeus installations at a handful of locations where vital command and control facilities will be located. As the impact of ballistic missile guidance accuracy increases more greatly, additional support may be needed for at least a few Zeus missile interceptors.

If and when this occurs, it could generate strong political pressures to expand the number of Zeus installations for additional areas, leaving the new Administration to accommodate the entire program.

Despite concern expressed by Navy officials over the prospect of Soviet submarine-launched ballistic missiles, the general consensus of Defense Department thinking is that the Russians have not launched a major ballistic missile submarine program, nor are they likely to do so. This is based on the fact that

it is more and more economical for the Soviets to lay down more ballistic missiles in the vast reaches of the Soviet Union and to coordinate their launching in a surprise attack than to order to submarine-launched ballistic missiles with the problems of coordination.

If the Defense Department should sense that support and become seriously concerned over the threat of submarine-launched missiles, this could generate added support for Nike Zeus production. Reason behind that is that the small ballistic missile that has been launched from a submarine cannot carry sufficient payload to permit widespread use of decoys. Furthermore, its intercontinental range ballistic trajectory makes the weekend as easy target.

The Administration has asked for \$180 million in Fiscal 1961 to continue Nike Zeus research and development and to provide sufficient tests, command, control and test missiles and test targets facilities to carry out full-scale tests over Kwajalein Atoll in the Pacific in 1961.

These tests are expected to provide "adequate knowledge in the whole field of missile tests," (which) will be highly useful whether or not Nike Zeus ever goes into production," Defense Secretary Gates said during recent House appropriations hearings.

In addition to Nike Zeus, Defense Department's Advanced Research Project Agency is spending about \$100 million on Project Defender, a program intended to learn more about the radar and infrared characteristics of a ballistic missile in flight and its space course during reentry as well as exploring other ideas for a possible active defense against ballistic missiles.

Sky Bolt Moves Ahead

Washington—Approved to begin development of the Air Force Sky Bolt air-launched ballistic missile Nike TB-12A, was granted last week by Director of Defense Research and Engineering Herbert York after review of original design objectives and timetable to meet realistic goals (AW Jan. 4, p. 1). Following detailed analysis, Air Force and Defense Dept. officials, it was decided to use the design objectives as a guide to set the missile's size and to submit the original baseline. Air Force has established a Super WSOFF (Super Weapon Office of Future) program project at Wright Air Development Division, which will be level proposed, to manage WSOFF program. Dr. York's office also will manage program closely.

Westland, Fairey Complete Plans To Form Helicopter Combine

London—Government speed in solution of the British aircraft industry's problems is virtually certain, says an agreement to merge Westland Aircraft, Ltd., and United Kingdom aircraft interests of the Fairey Co., Ltd., into a group which will combine almost all British helicopter manufacturing in one body.

The agreement is to be effected by sale of the merged share capital of Fairey Aircraft Ltd. to Westland for about \$9.24 million in cash and shares from Australia, introduction of the Fairey Co. operates all of Fairey's U. K. activities in Britain.

The new combination, which will constitute a specialized helicopter group capable for government support will make Westland the principal helicopter manufacturer in Europe. The Westland group already includes Saunders-Roe and the helicopter interests of British Aircraft.

It will be Westland's aim is a policy of integration to maintain maximum efficiency and to meet at least and exceed the ever-growing requirements from foreign helicopter manufacturers.

Westland will continue to develop the Sikorsky VTOL aircraft project and arrangements have been made for the development contract with the government—scheduled to be worth about \$17.2 million—to be signed "forthwith." Westland will be able to offer a range of seven types of helicopters from the two-seat Skimmer to the Wessex ship.

The company also plans to develop a four-place helicopter version of the Wessex with improved performance at altitude. The prototype is scheduled to fly this year. A four-place, covered up to 14 passengers, will be suitable for operating up water taxi, off-shore or other services. A second new type is the Wildcat (AW 119, p. 10), a four-place helicopter with twin Gnome engines (to take with three engines) for both engine and civil work and carrying up to 25 passengers. The first Wildcat is expected to fly this year.

Westland also will probably take over work on the Fairey Gannet anti-submarine aircraft.

Fairey investment and activities in the aircraft manufacturing companies (Aircraft Development Board) to build the DH 121 for the British Empire Airway, ultimately, will be taken over by Westland, it is believed, although Westland will not concentrate on its Avro planes at this stage.

After holding Fairey assets, the Fairey Co. will sell seven major subsidiaries. From U. K. subsidiaries are: Fairey Engineering (airframe repair), Fairey Marine (gliders and submersibles), Aeroplanes (planes) and Fairey Air Services. Abroad, the company's chief subsidiaries are: the Fairey Aircraft Co. of Canada, Fairey Aviation Co. of Australia Pty., and Fairey S.A. Belgium.

Sale of Fairey Aviation capital to Westland will be effected for the following consideration: the sale to the Fairey Co. of two million Westland shares of five shillings (70 cents) each, credited to fully paid (not making for forthcoming Westland issue in new all registration) to occur in that day fixed for the period ending Sept. 10, 1959; and a cash payment of about \$1.5 million.

Shares will be distributed to Fairey Co. shareholders in the proportion of one Westland for every two Fairey shares held. The necessary adjustment, since the current distribution of new Westland shares (not Fairey) will receive, will be made by purchase.

NASA Pilot Escapes In Vertiplane Crash

Meftert, Calif.—Army-Bu. Vertiplane, research VTOL aircraft, was destroyed in a crash here after it pitched up through 180 deg and dived 5,000 ft to the ground in an inverted attitude.

The experimental aircraft was severely damaged after its National Aeronautics and Space Administration Ames Lab crash test program with 11 successful flights in six preceding months.

NASA test pilot Glen W. Swenson ejected at 1,600 ft in an inverted position. He bled out as a result of the impact on the ground because he was hanging on the seat belt and shoulder harness. A Norton chase plane was flown in Buja test pilot Lon Thayer. The aircraft was in level flight at a low power setting and low dip deflection after the initial pitch up began.

Army designer Martinus de Vries, RAE, The Army phase of the Vertiplane program ended about three weeks ago and NASA personnel were checking out on the aircraft when the crash occurred. A few days ago, the Vertiplane flown in Buja test pilot Fritz Grund was damaged in a hard landing when a propeller transmission failure occurred (AW Aug. 11, p. 10).

News Digest

Atomic Energy Commission awarded a contract to Blue Kites Co. last week to study the facilities required to test an indirect cycle nuclear engine system of the type currently under development by Westinghouse Division of United Aircraft Corp. for AEC and the Air Force. Facilities will be located at the AEC Nuclear Research Testing Station where all present test facilities are designed for direct cycle powerplants such as the system under development in General Electric.

Molecular ammonia amplifier is being developed by TRG, Inc., Roswell, N. Y., under a \$118,000 Rome Air Development Center contract. The low noise amplifier operates on a new principle and offers both high permeability and linear amplification, although it has characteristics in common with both.

Mathia Co. will continue research and development of subsonic ramjet engine under an \$82,999,600 follow-on contract from Department of the Army. Contract brings total fiscal 1960 funding for Project to \$115,857,000. It covers production of ramjet, ground support equipment testing and flight and environmental testing.

Rothrock Co. and Compagnie Generale (CGF) of France have signed an agreement to exchange data in the interim test bed.

Helicopter Arm. of Great Britain has been liquidated and its activities transferred to the newly formed Rotocraft Section of the Royal Aeronautical Society.

Accounting Division of Ford Motor Co. will study design of a system to aid accountants in cataloging and evaluating satellite units under a contract from Air Research and Development Command.

First hardware for machine translation of Russian scientific and technical literature for USAR will include an IBM International Business Machines computer capable of translating 150 phrases per second into English. Other hardware is a Burroughs print reader and a Shepley adapted output printer.

Bell X-1A VTOL has completed flight test phase in conventional aircraft configuration, including better tests after maintenance and maintenance tests. The 44-year-old aircraft will start its transition from flying straight from conventional toward flying position in small increments.



Tu-114 Flies Russian Delegation to New York

Manufacturing information and minor changes from the Russian Tu-114 Soviet No. 5413 that brought Premier Khrushchev to the U. S. last year indicate that this helicopter engine, ported at the New York International Airport in Newark, is a Soviet one. The plane brought a delegation of members of Russian republic here for a U. S. test last week. The serial number 74400 is not an indication of overseas still since the Russian numbering system was revised last year. It may be significant, however, that this is the first time so aircraft other than 5411 has appeared in a photograph, except in the case of Tu-114s. Modifications include alterations of the tail fin to short half.

At previous tests and demonstration of the design test on the leading edge of the jet. Counteracting propellers do not show the leading effect that appeared on the rear of the Miles No. 5411 and the aerodynamic air was made only a single horizontal stage on the leading instead of multiple stages as 5411 (AW Aug. 17, p. 10). On its second flight from Moscow to Leningrad, the Tu-114 spent 13 hr. 51 min. in the air, at least 30 min. of which was over the New York airport. Landing might have shown the flight down somewhat. It arrived via Khrushchev, overflew Greenland and crossed the northern Canada before coming back over Canada and to the New York area. Cruise altitude was around 12,000 ft.



Crew Issue Sparks New Labor Debates

Salary costs could triple within next two years;
pilots may make strong bid to cut flying hours.

By Robert H. Cook

Washington—Status of the controversial "deadweight" station on jet transport crews is shaping into a hot factor that may play a major role in labor management contract negotiations during the coming year, leveling off new rate union as well as labor management bodies.

Heavy exposures already incurred by the airlines in extra salaries for addition of a third pilot, at the Air Line Pilots Assn. demands, while entering a flight engineer, as the Flight Engineers International Assn. demands, are expected to triple within the next two years.

ALPA, which sees no need for a non-pilot-third crew member on jet transport crews, contends that a third pilot is necessary in order to provide a "full crew" (see commentary).

The three airlines which have accepted the third pilot flies two American, Eastern and Trans World—control that the fourth crew member was added in order to bring contract negotiations to a successful close rather than struggle with the viability of ALPA's "full crew" concept. The three airlines also have released flight engineers on jet crew.

ALPA, as the other hand, said it still intends to fight for a three-man crew, all at those pilot's rates.

Intensity of the dispute recently approached a new crisis when Eastern sought a court injunction to require its pilots to take Douglas DC-8 flight training.

Company spokesmen said the ALPA chapter's refusal to take the training voluntarily was based primarily upon a desire to increase flight engineer training beyond the amount agreed upon a year ago. The pilot's control additional training is needed, while the flight engineer's control additional training is needed.

• **Whereas** . . . experience has proved conclusively that a third pilot on jets is not needed (even less than no pilot-third crew aircraft) for safety reasons.

• **Whereas** . . . pilots argued to second officers have been placed in a hazardous job where their proficiency as a pilot has deteriorated.

• **Whereas** . . . a third pilot in monthly flying hours on jet will either accept a less working conditions, provide for a hedge against technological unemployment, or for better job opportunities for crew TWA pilot and.

• **Whereas** . . . ALPA's demands the only recognized method to combat technological unemployment as the labor movement has been a reduction in working hours.

ALPA Council No. 4 in Los Angeles, where a high percentage of TWA jet pilots are domiciled for contractantant

• **Therefore**, he it motioned that the TWA pilots be pulled into a staff ballot on the following proposal: "That the TWA Master Executive Council obtain permission from the Board of Directors of ALPA to permit the TWA pilots to request the contract pertaining to jets for the purpose of achieving the monthly maximum (flying hours), to increase the rate of pay (pilot's profit) and to create the demand for three pilots."

ALPA headquarters spokesmen in Chicago were unable to resist late but not effective the resolution request but hoped to be repeated later next week, while the reduced working hours could be negotiated with the company.

In TWA contracts, no move to drop the third pilot would require a vote of ALPA's Board of Directors in charge of the union's side pilots.

Trans World Airlines spokesmen on the airline has received a mounting number of requests from individual pilots on the company's stand on extra salaries for third pilot's flying hours. The possibility of dropping "an important for three pilots on jet operations."

Noting that TWA accepted the third pilot only because of its contract agreement, the airline spokesmen said a general letter of reply to the question that TWA has not changed its position that a third pilot is superfluous, it is, under the Boeing 707, not the Boeing 747.

The airline said a third pilot is necessary for safety as well as efficient aircraft operation.

The airline's letter to the pilot's council, "We think that both the pilot and the company would, in the long run, benefit in the elimination of the contractant requirement for a second officer."

It added that any discussion of the possibility of reducing pilot hours could only be conducted with ALPA.

Average experience of those pilots ranges from three-and-a-half years flying time on the 747-100 to a year and a half on the 707-400, operational cost of about \$5 million a year for the 747-100, and \$1 million a year for the 707-400.

By 1963, American, TWA and Eastern will have a total of about 140 aircraft, which they say will require 600 third pilots at an additional cost of about \$5 million a year for the three airlines.

At present, third pilots are just beginning to enter Eastern's payroll.

Third pilot expense breakdown would be approximately \$16 million for Eastern, \$2.4 million for TWA and \$1.2 million for American.



Delta's First Production 880 Makes Maiden Flight

Model 880 of Delta Air Lines' first production Boeing 800 transport landed 1 hr. 11 min. with William B. Harwell, General's chief of production flight, on the controls. Delta reports Boeing Agency certification by May, and then will put the 880 on scheduled routes from Miami and Atlanta to the West Coast, where he ordered a fleet of 10. In his third flight test 880s have logged more than 740 hrs. of flight time.

be approximately \$16 million for Eastern, \$2.4 million for TWA and \$1.2 million for Eastern by 1963.

Actual duties of the second officer are the same as for TWA and American, where, the airline says, he is specifically function as an "administrative assistant" to the pilot in command by keeping running log books and records, acting as radio and navigational coordinator, watching the fuel gauges, traffic and managing a cockpit window in the event of emergency, except that of the pilot in command. He is listed at third in command by both airlines and must have the minimum cockpit qualifications, including a commercial pilot's license, instrument rating and sixth in the air.

Eastern Air Lines' spokesmen said they intend to make maximum use of their third pilots, who are divided three between "supercracked" jets in flight and actual time at the gate on the ground. Eastern wants to give the third pilot equal flight experience with the first officer, reducing the cockpit on many flight operations.

Further fact has been added to the third pilot issue with recent reports that some TWA spokesmen had advised second officers, in sign their parents and wives, to leave.

A note from the ALPA chapter chairman at TWA called pilots' attention to the fact that "in our own mind we cannot see the suggestion as actually correct."

The note warned that such action was in direct violation of company regulations and ALPA's contract agreement. TWA also pointed out that the airline is light crews argue against such measures and asking that any reduction be reported. Company officials say they have not found any proof of the alleged violations.

British Order 707 Modifications

Seattle-British Air Registration Board has called for a series of modifications on the Boeing 707-400 transport in order to British Overseas Airways Corp. before it will certificate the aircraft for scheduled BOAC service.

Specifically, the British board has ordered a 35 in. extension of the vertical fin, full-time middle berth, modification of the wing dampers and the addition of a small control fin. Boeing is conforming with the order and has submitted the first two of BOAC's proposals, which have been long for modification.

Two other aircraft, which are scheduled for rollout in about three weeks, are under completion, and probably will receive the modifications in the future. BOAC has 15 of the 707-400s, which are powered with the Rolls-Royce Conway turbojet engine on order.

BOAC Considers Super VC-10 Transport

London—British Overseas Airways Corp. may strengthen its long range services by the purchase of a number of Super VC-10 jet transports from Vickers Aircrafts (London), Ltd. BOAC order is understood to be under consideration. The Super VC-10 will carry up to 200 passengers, 10 more than the VC-10. It is scheduled about 30 ft. more double deck and will have the wings.

If the project goes ahead, the airline would have the Super VC-10 into use as used 1964-1965, after the VC-10 (VW 104) 1961-1965. Currently, BOAC has VC-10s in order from Vickers-Aircrafts, with an option for 20 more.

No specific numbers have been given for the changes. However, AIR's chief pilot D. F. Davies said the aircraft for about 10 in. some time ago and, at that time, certain had modifications would make the plane acceptable.

Two weeks ago, ARB notified the manufacturers that the 707-400 would be required to demonstrate control and stability in approach, attitude landings and climb-out with two engines out on the same side. Federal Aviation Agency is not requiring the performance test on the aircraft because of the small probability of losing two engines in the same side under operating conditions.

The test is made more difficult by the fact that the Conway engine has about 1,000 lb. more thrust than the conventional rating of the Pratt & Whitney JT5 turbojet engine. The added thrust tends to increase wing moment, momentarily only in momentary thrust.

Vertical fin and rudder boost modifications are intended to cope with the problem caused by the two engines continuing out situation. The larger modification is designed to add a little roll-over to the rudder. Vertical fin is a small—about two feet deep and six to seven feet wide. Vertical fin extension will be accomplished by adding a pin.

Being a modified with Rolls-Royce conversion of prop, piston and supercharger systems for the Conway.

Douglas Aircraft Co. spokesmen say that generally, and within of the Conway-powered DC-8 will be exactly the same as the DC-8 equipped with the JT5 but that momentary controllability is good with an engine out will be higher.

Douglas does not have to run as ARB certification test now it has as a transport to British operators.



Air France jets were flying before Gigi was born!

Gigi is six. Yet it was more than six years ago (February 28, 1955, to be exact) that Air France began flying regularly scheduled pure jet service!

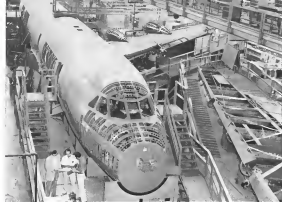
Since then, Air France has logged over 4 million jet passenger miles. First, with the sleek, vibrationless, 500-mile-an-hour Caravelle. And now, Air France has added the fabulous new Boeing 707 Intercontinental to its fast-growing pure jet fleet. The Intercontinental is the world's fastest, largest

longest range jetliner crossing the Atlantic non-stop between New York and Paris in only 6½ hours.

The Boeing 707 Intercontinental is the speediest, toughest tested airliner in aviation history. First, with thousands of hours of testing on the ground, then, more thousands of hours of actual flight.

Yes, Air France jets were flying before Gigi was born. A reassuring fact to remember whenever you fly overseas on the world's largest airline.

AIR FRANCE JET
WORLD'S FASTEST JETLINER / WORLD'S LARGEST AIRLINE



Concor Builds Metal Mockup of 600 Jet Transport

Metal mockup of Concor 600 turboprop transport will be used to check out design changes for customers and to assure uniformity of structural wiring, hydraulic lines, instrumentation, flight controls and tubing. Aerodynamic mid-deck bulges (NW Sept. 8, 1952, p. 10) on upper wing surface are dropped to improve speed capabilities; the 600 is expected to attain 615 mph. Wing leading edge ducts are incorporated on the metal mockup. First aircraft (background) is scheduled for factory completion in July.

Airlines, Post Office Clash Over Mail Rates

Washington—Civil Aeronautics Board hearings in the New-Pennsylvania Mail Rate Case opened last week with the Post Office Department and its carriers still differing sharply on the level of mail rates that should be established (NW Nov. 2, p. 51).

In a first trial round, case roadblocks stated that the new priority mail should include not only first-class and other preferred mail and first rates established for this category should not apply to air mail and air parcel post. The carriers and their would-be rates for priority mail to be set at 100% of former charges—costs attached to the ground handling of the mail—plus 52% of the last-hand charges now in effect for regular air mail under the present multi-element formula.

The carriers also asked that a maximum of \$4.80 per shipment for the carryweight must be established. All air priority mail would be carried on a strictly space-available basis.

The Post Office wants charges representing 50% of both last-hand and forward charges, the rate level proposed by the CAB in its original order. In testimony before the Board George M. Moore, assistant postmaster general in charge of the Bureau of Transportation, said the airlines would not be used for the transportation of mail at rates above 50% of the

present air mail rates now in effect. He told hearing Examiner Ralph L. Warr that Post Office budget limitations would prevent early air "field" use and in the foreseeable future. On the subject of priority, which also proved to be a matter of disagreement between the carriers and the Post Office, Moore agreed that nonpriority mail should be handled on a space-available basis without obligating a carrier.

He added, however, that the Post Office would have no objection to the Board setting down legal ground rules that would establish a priority for mail lower than that for regular air freight but higher than deferred air freight. He said this should be applied to all carriers at the option of each one.

The case carries on in this post-shipment that leaving the discretion of meeting mail in relation to the carrier's air freight to the individual airlines would allow the "Post Office Department to place one carrier against the other."

The carriers are American, Braniff, Delta, National, Northwest, Northeast, TWA, United and Western.

Concorve Turboprop

Recent, Cold-War 50% of the flight evolution testing of the Alouette 500-615 turboprop-powered Super Concorve for Federal Aviation Agency air traffic has already been completed. Full certification is expected by May 15.

Concorve is turboprop redesigning has been done by Precision Engineering Corp., a wholly-owned subsidiary of Pacific Aeronautics Corp.

Alouette reports four previous orders for 11 corporate conversions of the Super Concorve plus five airline conversions for Life-Central Airlines, which also has option for 16 additional conversions.



The new Boeing 720 offers airlines the lowest seat-mile cost of any jetliner

The newest jetliner in the world—the Boeing 720—is pictured above during a recent test flight. Delivery of the first 720 is scheduled for this spring. To date, forty-six Boeing 720s have been ordered by leading world airlines.

The new 720 is designed to operate efficiently and profitably over short-to-medium range routes. The 720 cruises at speeds in excess of 600 miles an hour, and has the lowest seat-mile cost of any jetliner. In addition, the 720 can operate more

economically from shorter fields than any other jetliner. Seating capacity ranges from 80 to 150 passengers, allowing airlines unusual flexibility in seating arrangements.

As demonstrated by Boeing jets already in service, the 720 will bring airlines unprecedented passenger appeal and high daily utilization.

Boeing 707 jets have already flown more than 60,000,000 miles in scheduled operations and have carried more than 2,000,000 passengers.

BOEING 720

CAB Postpones New Subsidy Formula

Washington—Local service airlines won a 30-day reprieve last week from new Civil Aeronautics Board subsidy standards designed to curtail subsidy payments to a strict formula of flight scheduling.

Formulated by CAB as a means of getting all local service carriers on final aid rules by next Dec. 1 (AW Feb. 1, p. 18), the plan has been under serious fire from the carriers. They have contended that they had less than a week's notice of the proposal before it was to have gone into effect Feb. 1.

Extending this date, to Mar. 1 to permit the airlines to file their comments, CAB noted that time for comment was conspicuously allowed in regularly proposed rule changes not deemed necessary in this case, since the proposed formula is intended only as a "guide line" for future local service scheduling to permit a more precise computation of subsidy payments.

Any specific problems the new scheduling standards might create will be considered on an individual airline basis during oral rate hearings planned this year.

CAB said the scheduling standard concept, which generally makes subsidy in an daily round trips on a flight segment, is not new but has been applied in the past in computing subsidy based upon a subsidy for four round trips per day. Expanding the standards to cover five and six trips, the Board said, is intended to create a situation grounded by accurate scheduling and reflect CAB philosophy that local service schedules should produce "higher level" fares with the addition of more flights to allow for further subsidies.

Local airlines deny that clearance of CAB's new rules can result in a review of back in flight schedules and a resultant stifling of industry growth. They contend that the plan amounts to CAB selection of the subsidy control factors of the industry before it has had time to make its own decisions.

Some local service carriers from the CAB standards a "strict disallowance schedule" designed to curb local service subsidy needs.

While the Board will refer to schedule standards in the specific rate setting, CAB said that local service airlines scheduling and service per flight will follow the general formula.

One round trip. Subsidy provided to cover the gap between total operating expenses and financial revenues on Douglas DC-3 flights. Seven to eight passengers will be required to be larger

several before subsidy will be paid.

Two round trips. Traffic must average five passengers per plane mile for the DC-3, nine to 10 passengers for larger aircraft in order to qualify for subsidy.

Three round trips. Revenue must equal direct flight costs.

Four round trips. Revenue must equal direct costs plus 15% of ground and indirect costs.

Five round trips. Revenue must equal direct costs plus 65% of indirect costs.

Six round trips. Direct costs plus 55% of indirect costs.

More than six round trips. Airline must earn the same amount to cover direct, ground and indirect costs.

The CAB noted that its table is based on an average fuel efficiency of 7.23 cents per average passenger mile, plus five cents per plane mile for other associated costs.

The Board said that any increase in carrier scheduling per route segment

will not be recognized for subsidy purposes unless the airline clearly provides the new scheduling standards.

As an example, a carrier's earnings on a three round trip frequency would have to meet CAB's standards for the four round trip—revenues at least equal to direct costs plus 15% of ground and indirect expenses—before the airline could expect to receive an additional flight. Should the airline meet these requirements, the added flight would be recognized for a six month period and thereafter if it continued to meet the four round trip standard.

The Board maintained that it should not see revenue standards as a deterrent for the six-month period will be automatic, so that an airline's revenue requirements during a period of seriously low traffic would not automatically be recognized.

In the court case expansion of flight frequencies fails to meet the CAB standards, the Board will apply a disallowance formula that will permit the carrier to action from 10% to 85% of the current revenue standard, with punitive increments of 10% for more than six round trips. As an example, on a five round trip frequency, the carrier would be permitted to receive 60% of the current revenue standard but would be disallowed direct flight costs plus 65% of ground and indirect costs for the mileage not recognized.

A breakdown of CAB's estimate of per plane mile revenues and average passenger loads necessary to meet the new standards, covering DC-3s and other aircraft, such as Martin, Cessna and Fairchild F27s, includes:

One round trip. DC-3, no requirements. Other aircraft earnings of \$5-10 cents per average plane mile, with an average load per mile of seven passengers.

Two round trips. DC-3, five passengers and 11 cents. Others, one passenger and 10 cents.

Three round trips. DC-3, 8.33 passengers with 65 cents. Others 11.10 passengers plus one dollar.

Four round trips. DC-3, 10.35 passengers with revenue of \$1.00. Others, 17.35 passengers and revenue of \$1.30 per average plane mile.

Five round trips. DC-3, 13.75 passengers, \$1.04 revenue. Others aircraft, 20.35 passengers, revenue of \$1.55.

Six round trips. DC-3, 15.42 passengers and revenue of \$1.16. Others, 21.23 passengers and revenue of \$1.72.

Seven or more round trips. DC-3, 16.67 passengers per mile with revenue of \$1.51 per plane mile. Others aircraft, 23 passengers and revenue of \$1.83 cents per plane mile.

Mohawk Leaves ALTA

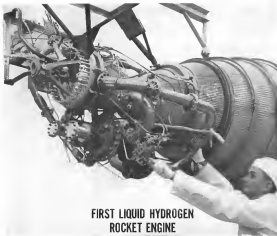
Washington—Mohawk Airlines stepped from the Aas of Local Transport Airlines last week in a more appropriate financing from the carrier's shareholders with a special request request prepared for ALTA.

Mohawk request, effective Feb. 26, is a letter to the industry association and all other ALTA's and non-ALTA's local service carriers.

Private capital among local service carriers to the industry-owned "one and one half" by Mohawk, officially stated its resignation was not based on any one particular area but stemmed from "confidence disagreement" with ALTA policy.

Other industry carriers, however, noted the airline specifically objected to a study of the industry by Planning Research Corp. of Los Angeles, Calif., (AW Feb. 1, p. 36) as grounds for the company's request that Mohawk (which had \$27 million in subsidy for 1969 while the union was in a final year of only \$2 million during the year) Mohawk for the entire \$700,000 in extensive subsidy than the prior year.

The airline also was understood to have objected to other portions of the report covering Canada 140 operational efficiency and a discussion of subsidy standards by industry, which, according to Mohawk's press office, states of "This, N. Y., which is the carrier's headquarters, would require greater subsidy support than a majority of cities dependent on local service subsidies."



FIRST LIQUID HYDROGEN ROCKET ENGINE

Pratt & Whitney Aircraft's XLR-115

Develops 30% Greater Specific Impulse... Offers Unlimited Potential in Size and Power

The first of a new family of liquid hydrogen rocket engines for missiles and space vehicles has recently been demonstrated at Pratt & Whitney Aircraft's Florida Research and Development Center. The engine developed 18,000 pounds of thrust under simulated space conditions, and produced 30% higher specific impulse than conventional kerosene engines. The successful development of this engine opened the way for immediate development of hydrogen engines offering far larger size and power.

The new Pratt & Whitney Aircraft engine has been chosen to power the Centaur space vehicle atop a modified Atlas missile. It will also power an upper stage of Saturn, the booster that will be used to place 35,000-pound satellites in orbit 300 miles above the earth or send a 12,000-pound space probe to another planet. Current developments indicate liquid hydrogen, substituted for kerosene stages, can multiply payload as much as 8-1/2 times.

A new pumping system—termed "booster" pumping—eliminates the need for an auxiliary gas generator. Pumping power is provided by the expansion of the hydrogen itself.

Pioneering work in liquid hydrogen has been in progress at Pratt & Whitney Aircraft since 1955.



PRATT & WHITNEY AIRCRAFT

East Hartford, Connecticut
A Division of United Aircraft Corporation



Air-India Schedules Boeing 707-420 Transatlantic Service

Air India International announced plans recently to begin transatlantic service with Boeing 707-420 turboprop equipped on May 16, linked service will include five flights per week between New York and, alternately, Bombay and Calcutta. Flights will operate monthly between New York and London, serving three intermediate points on the London-India leg of the route: Paris, Rome, Frankfurt, Geneva, Beirut and Cairo. Delivery of the first of four Boeing 707-420s on order was completed last month, and the company is scheduled to receive two more in early March. The planes will be powered by Rolls-Royce Conway turbo-prop engines and carry 40-45 Boeing passengers plus 80 economy-class passengers. The new route will be operated on the basis of a freight agreement permit signed last November by President Eisenhower under the terms of a bilateral air transport agreement between India and the U.S.

General Dynamics Chief Presses For Common Air Freight Carrier

New York—Airline men will have to get into the cargo business themselves through the formation of a common air freight company on the order of the national Pullman company—or their customers or surface competitors may have their own fleet first, Earl D. Johnson, president of General Dynamics Corp., said here last week.

Making no pretense that General Dynamics was not vitally concerned in the field because of its Canadian subsidiary, General's GL-H helicopter program, Johnson told the Sales Executive Club one manufacturer General Dynamics had studied could apply to buy a fleet of 15 CL-44s now and run them on a daily schedule.

He did not identify the manufacturer or even the country. But he also made frequent references to auto parts shipments from Detroit to assembly plants in Kansas City as examples of air freight markets and both General Motors and Ford have made provision of this type.

He did not identify the manufacturer or even the country. But he also made frequent references to auto parts shipments from Detroit to assembly plants in Kansas City as examples of air freight markets and both General Motors and Ford have made provision of this type.

Candid References

Johnson described his personal speech, and his spontaneous talk was studded with pungent references not only to air freight—the advertised subject—but to the nation, business as well. "Today you can sell a jet transport to anybody you can give the money to buy it."

• Sales of the CL-44 are not moving as fast as the company would like, he added wryly. "When we look at airline balance sheets on the short term, we can begin to make arrangements for this attitude. But when we look down the road, we see the tremendous task ahead that will be guaranteed by the jet and it looks as if it won't be too long before it will be possible for them to lose their freight."

• "Uncle Sam" is not going to spend another big sum, except in a few cases. "Looking ourselves, we're not making much change order," he said, "and our people don't want to work out... supporting expensive projects that run or may not have some usefulness."

A good news attribute are going to have to change, Johnson asserted, not only among manufacturers and airlines, but among passenger agencies and financial people, if the aviation business is going to adjust to the future.

In the air freight field, for example, he pointed to the central necessity for separate terminals for air freight. "We have had to have air freight handled at passenger facilities up to now," he said. But the New York Central doesn't have air passenger terminals in the middle of its freight marshaling yards."

Spending facilities and specialized ground handling equipment will be needed for the coming air freight race.

Let and he called for particular attention to the problems from financial sources.

Another practice that he said will need re-examination is "loading the wheel" of each pilot or group of pilots on his usual dumps at the locations of various instruments and controls so that each airplane becomes a piece of custom equipment at added cost.

Military pilots handle standardized aircraft, he said, and military airplanes can be maintained on a standardized basis.

Standardized Freighters

That a standardized air freighter—powered by a common Pullman-like company as train owned by various airlines—could be flown to Kansas City and assembled by Trans World Airlines, in Tulsa and maintained by American and by San Francisco and maintained by United.

Freight airlines are going to face some such coordination, he said, pointing to the Air Union explanation, "How long can we stand cutting each other's throats in needless competition?"

Both the railroads and the airlines are moving into air freight, he said. The railroads know their own fight the advent of air freight.

"We know that," he said, "because of the people who are looking at our door." He said that as far ahead as he could see, air freight will not become as cheap as the railroad 14-1/2 cent box mile cost. But air freight already is raking off the rail's high profit margin because...

U.S. Supersonic Transport Action Urged

By Glenn Garrison

New York/Trenton: Jet supersonic transport service has been placed around 1965 by two major manufacturers—but their are more important considerations. North American Airlines, which made clear its determination to enter the supersonic commercial field at the Institute of the Aeronautical Sciences meeting here, and Lockheed Aircraft Corp. both said that a U.S. Mach 3 transport could be flying within routes at about that time, if an aggressive development program was started immediately. Both wanted—and were in effect supported last week by Civil Aeronautics Board Chairman James B. Doolittle—that U.S. delay might mean a loss to foreign competition.

Some airlines, however, were looking further into the future for the first in a series of commercial supersonics. Besides the big question of where the fleet will come from to build and buy the transports, airline operators were asking the highly technical next step: when to fly.

The carriers want to see positive answers to many economic and operational problems before they line up to

replace their only now subsonic jets with the supersonic variety. Several key engineering officials surveyed by Aviation Week said it would be two or three years before any manufacturer would have designs to build anything there have for some time been discussions between airlines and manufacturers on supersonic prospects. Translating a few designs into a working airplane with unique problems involved in reducing noise, the supersonic operator would own the first aircraft to fly up to at least 1968 or 1970 they say.

Cost Experience

The U.S. approach to beginning subsonic jet service was contrasted by one official with the British de Havilland Comet I experience. American airlines, it was pointed out, tended to run with the manufacturers to ease and solve the many operational problems going along with service. The British, according to this view, went about two feet to anticipate problems that further airlines might have avoided.

Anyway, the development problems that will take time to work out, in the airline view, is that of certification of a

supersonic transport. This process will involve whole new areas of standards and techniques.

North American and Lockheed presented their arguments for an immediate development program at the IAS meeting here.

North American called for an aggressive U.S. program to be undertaken without delay. J. B. Parsons, Jr., and R. James Pfeiffer reported that the U.S. industry is at an excellent position to maintain its leadership in jet transport competition and could place a supersonic airplane in service by 1965 with a level of cost comparable with subsonic aircraft of current jet transports.

But North American's main estimate was based on "a free gasoline now," and the officials know how hard developing new costs as well as a competitive advantage if the program were delayed. The price factors, they said, would be a major problem. North American's opening pitch in the supersonic commercial contest as far as an official paper is concerned. The company has had a continuing talks with the airlines about supersonic possibilities, but said that the airlines could share in the high management level of other manufacturers have.

Pfeiffer, who is North American's new manager-commercial aircraft marketing, told Aviation Week that no policy decision has been made on a supersonic project, which at "purely in the study and planning stage." Further plans would depend on just on what the development costs problem, and its immediate effect on the development of a jet engine for the supersonic transport—the key principle being considered by North American the last magazine.

North American's B-70 competitor is the General Electric YF-12. But Pfeiffer said both General Electric and Pratt & Whitney plan several of cutting military requests that could power a supersonic transport, so North American is not specifically at Pratt & Whitney's competing engine is the J58.

An prime contractor for the B-70 Mach 3 bomber, North American appears to have a strong lead over most other manufacturers in the supersonic field, says airline industry but. Con- vail's B-58 is on the Mach 2 category and therefore is not considered a great advantage in Mach 3 manufacture.

Lockheed Aircraft Corp., also can make a strong case as a contractor, says an Lockheed spokesman on economic issues who the U.S. should not expect a supersonic transport between 1965 and 1970 in their 198 report. B. C. Messersmith and Robert A. Baker suggested looking the answers to be

in most manufacturers as a possible approach to the development problem. One basic benefit, it is generally agreed, will come off U.S. interest, in being developed that means that one design could be economically successful.

Durfee, in a letter to Chairman Warren G. Magnuson (D-Wash.) of the Senate Committee on Labor and Foreign Commerce, said, "The economic stakes by U.S. manufacturers indicate that the entire requirement of all the world's air carriers could be met with 100 to 200 supersonic airplanes. Estimated cost of such airplanes, Durfee said, is between \$12 and \$25 million.

No manufacturer, according to Durfee's information, could build without 90 to 98 million for supersonic aircraft. Durfee probably would see interchanging manufacturers to get sufficient production to neutral the competitors.

Durfee and Galt were concerned that a race to develop first in supersonic transport development in the country would mean that the U.S. would lose 1950 "the American long range carrier race be forced by competitive reasons to place order for supersonic aircraft to be built elsewhere in the world" and the favored portion of the U.S. would be lost for decades.

The Galt brothers' letter might be contrasted in showing the ground work by government leaders of a supersonic transport program in some form. Help from the government has been suggested as an alternative by the manufacturers, and there is no emerging as a state approach to the problem. Stetson said at the B-70 program has been mentioned in this connection is an unresolvable development in the supersonic transport in Lockheed's discussion.

Regarding the foreign transportation aspect, Durfee and Galt has been told that both Great Britain and France are "beginning to get operating supersonic transport between 1965 and 1968." According to the manufacturers, and "one of the countries is already 'cutting out' for its first supersonic transport aircraft."

The manufacturers in the IAS supersonic transport session were asked to some 105 questions submitted by top aviation engineering officials. This approach was suggested by questions concerning supersonic transport operations presented by Charles Herring, Eastern Air Lines' vice president engineering, at an IAS meeting last fall.

The questions covered last month concerned noise, structural design, powerplants, performance, financial aspects, operational factors and national policy.

The two manufacturers disagreed on the probable structural material of the Mach 3 category transport. North American maintained that considerable honeycomb sandwich construction with



First Sud Caravelle for Air Algérie

First Sud Caravelle jet transport for Air Algérie, the Algeria airline, is shown just prior to delivery. The Caravelle is the 30th of its type to be delivered for scheduled service and is the first of four for Air Algérie for scheduled between Tunis and Algiers.

that is (transom) would be used to handle subsonic flow, however, low aspect ratio wing, structural and other problems. Lockheed, however, favors a steel airplane with honeycomb construction and only in a few critical areas in a transport aircraft. Honeycomb and an aluminum fuselage could increase the cost prohibitively, according to Lockheed.

Development Costs

Lockheed estimated the development cost of a 150,000-lb supersonic jet airplane at \$350 million and the cost of a 500,000-lb airplane at \$210 million. Cost per acre of the lighter plane would run about \$11 million; if 100 were produced, according to Lockheed.

Washington was back in the supersonic transport in Lockheed's discussion. Some previous proposals had discussed passenger windows because of weight and structural requirements at some stage, says Lockheed. But Lockheed believes the design of the passenger, and who want to look out, can be provided with windows without a significant penalty.

The passenger also will sit with the plane at a change instead of sitting in a oval seat—another previous proposal by Lockheed and North American's next thinking. Manufacturers now might expect, according to Lockheed, that the aircraft will be 14 ft longer, 10 ft wider, 10 ft higher and 10 ft deeper than a standard aircraft should be. Sixty of aircraft would be needed to carry the same load.

Stock, noise, boundary layer and engine noise problems should be considered in the early design stages of the supersonic transport, according to three scientists from NASA's Langley Research Center. Langley's J. Lee, Douglas J. Maglieri and Harvey H. Hubbard pointed out that amount of people from coast to coast would kill the

business produced by a transonic aircraft jet cruising at 70,000 ft at Mach 3. The cost would be broken on such a flight would be 70 mi wide. But help for solution to the some known problems in how the aircraft is operated, according to the Langley scientists. Boundary layer noise is a possible source of structural fatigue, requires a vibration noise equivalent in the supersonic airplane than in the subsonic, they said.

Lockheed held that some basic problems would be avoided by the following typical check engine, which also is considered optimum for other operating reasons.

- Compressor equivalent steeper of 312 lb at 37,500 ft.
- Operating efficiency at 37,500 ft to equivalent altitude of 59 ft.
- Compressor equivalent swept climb at 570 lb to the Mach 3 speed noise climb.

North American instead stated that low-boiling systems for supersonic transports, rather than sea air mixture, on the basis of weight, power and reliability requirements. An emergency sea air system also would be provided. The supersonic body, the turbine engine with fan afterburning in the best powerplant configuration currently in sight. Models, an engine would consider the weight of the afterburning circuit, the specific fuel consumption of the turbofan, and the same level of the turbofan.

North American also advocated a burner engine configuration, for drag and structural weight considerations.

Operating early in the supersonic transport in North American's estimate, could be less than three orders per mile over long range routes. Required maneuver lengths, the two manufacturers agreed, would not exceed 10,500 ft. Under standard conditions.

Supersonic Airliner Development

New York—Officials of two major airlines say the commercial supersonic transport is at least a decade away from service and that the status of the North American B70 program will affect development time.

The president of a third airline—TWA's Charles S. Thomas—predicted supersonic operations around 1967.

Thomas said supersonic airlines could be available in three years, but the development cost would run to \$250 million.

American Airlines President C. R. Smith told a National Transportation Institute panel here last month that the manufacturers say the airlines have equal strength to develop a supersonic airplane.

Earlier last month J. A. Hefley, United Air Lines senior vice president-engineering and administration, expressed a "conservative" view of supersonic airline prospects to members of the Yale Engineering team of New York City. He predicted the service would not be in operation for at least 10 years.

Smith said "it is difficult to predict" that a supersonic transport will be in airline service within the next 10 years. He also questioned whether there is sufficient evidence that operators of such airlines would be profitable, and that there is no sound reason to expect it in development.

Governmental groups on the B-70 will greatly affect the development rate of the competing transport according to Smith.

Hefley and focusing on limitations of the human body was the two major problems in development of commercial supersonic aircraft. Development costs would reach a billion dollars according to the estimate of a Douglas Aircraft engineer he officials, Hefley said.

He also spoke of the difficulties involved in changing a supersonic airline when that would be considerably late from present day. Noise, high temperatures and noise have been among the problems to be solved, according to the United official.

A third issue of the limitations of such supersonic transports have been solved down a thick web by the current state-of-the-art of the B-70 program," Hefley said. He admitted his view was "on the conservative side," Hefley forecast that it will be "at least the end '70s" before supersonic airline operation is in service.

Earth-to-space ferry

for Astronauts



Combining the features of a space ship, guided missile and a conventional airplane, the new Space Ferry was designed by Hughes-Lockheed Proprietary to shuttle men and materials between earth and outer space.

The Space Ferry would carry a pilot and 3 astronauts. Payload would be about 14,000 pounds, cargo could vary from flight to flight.

Taking off from earth the Space Ferry would orbit at 300 to 500 miles, rendezvous with other space craft, transfer passengers and cargo, and return to earth... all on a routine schedule.

The Hughes-designed Navigation and Guidance System would utilize an inertial platform and a digital computer. It would automatically control boost to orbit, bringing the Ferry to within 20 to 50 miles of its destination.

The Hughes Attitude and Flight Path Control System would incorporate several novel features. A space attitude and translation control system, based on velocity feedbacks, would give the pilot easy control for

"Parasup" (paranetric coupler) developed by Hughes research engineers and scientists, can double effective range of today's radar units.



maneuver and find soft contact with the platform. For re-entry and flight in atmosphere, the system would use structural temperatures as a signal for automatic control during the critical heating phase. The resulting maneuver eliminates the characteristic stopping conditions of uncontrolled re-entries. Either pitch or bank (or both) maneuvers would be selected with electronic in-precision controls.

The new Space Ferry reflects the many stimulating outlets available to Hughes engineers. Other projects include nuclear electronics, spatial communication systems, advanced airborne electronics systems, three-dimensional radar systems, new semiconductor materials, electron storage tubes... and many others.

A diversity of advanced projects, a history of continued growth, technically oriented company philosophy—these factors make Hughes the ideal environment for engineers interested in building a rewarding future.

Privately conducted programs at Hughes Area research facilities welcome for engineers experienced in the following areas:

Guidance Systems	Instrument Engineering
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"Veez Pocket Air Defense System"—Hughes mobile digital computer and display unit. Built up a Hughes J.D. scanning radar antenna, controls enemy targets to missile intercept.

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AIRLINE OBSERVER

► Hughes Tool Co. has agreed to accept the first two of eight Boeing 780 turboprop transports it has on order for lease to Trans World Airlines. No money is being given for the aircraft, but this week is known both planes are ready for delivery. Current wants to deliver them right away, and since Hughes has paid at least \$25 million down on the purchase price of the first, money is not considered a factor behind the postponed acceptance of the two airplanes. To get at least one of the aircraft at the air, Current last week began flying it in a company-owned airplane.

► Wall Street sources believe changes are better for action on TWA financing over the carrier's existing picture. Highlighted notably last year. Earnings have been added to net worth in that equity financing may not be necessary since the carrier may now meet the debt/equity ratio required for long term loans, at least by issue leaders. However, the leaders have been ready to act on some type of financing for months but they still are waiting for the flight insurers to give the word.

► Capital Airlines has voluntarily replaced turbine blades and nozzle guide vanes on all its Rolls-Royce Dart turboprop engines. The program, completed in October, was undertaken when normal inspection disclosed that the parts were not meeting the expected lifetime of use to those engines involved periods before replacement was necessary under the company's regular maintenance schedule. Flight quality, blades and vanes were matched in the engine as a means of preventing future replacements periodically.

► United Airlines is still strongly interested in a fleet of Sud Aviation Caravelle transports powered with General Electric J47 turbofan engines (AW Nov. 25, p. 47). Current wants the aircraft for its medium-range routes.

► Civil Aeronautics Board has granted exemption to Braniff Airways and Pan American World Airways that will permit the carrier to serve Brasilia, Brazil, beginning April 1 on South American routes. Addition of Brasilia to an intermediate point on these routes was requested on grounds that traffic to and from the city will be substantial when the capital of Brazil is transferred from Rio de Janeiro to Brasilia April 21.

► Hearings by Senate Aviation Subcommittee on the proposed bill that would authorize the Civil Aeronautics Board to guarantee loans for the purchase of cargo transports will begin today. Under the bill as it is now written, loans up to 75% of the purchase price of each aircraft would be authorized, with a maximum loan structure of \$75 million on each aircraft. CAB would guarantee 90% of the balance of each loan.

► Eastern Air Lines will convert its Lockheed Super Constellation transports to all-cargo aircraft, with the first of the fleet to be in service May 1. In announcing the conversion program, Thomas Armstrong, executive vice president/finance, noted that air freight potential cannot be fully developed "until a more suitable all-cargo airplane can be operated."

► Trans World Airlines has estimated that around-the-world passengers will total 37,000 annually by 1962. E. O. Cooke, TWA's senior vice president and system general manager, made the forecast during testimony presented at Civil Aeronautics Board's Transatlantic Route Case in which the carrier is seeking an extension of its first route from Indianapolis to Chicago to Hong Kong and Tokyo via Bangkok.

► Leathem General Airlines has ordered five Boeing 720B transports powered with Pratt & Whitney turbofan engines for delivery beginning in April, 1961. The carrier also increased its order for Boeing 737-418 intermediate-range transports powered with Rolls-Royce Conway turbofan engines from three to a total of four.

► All Transport Area has contracted with the Stanford Research Institute to undertake a study of airport economies. Chief purpose of the study is to define economic benefits of airports to the area and the communities it serves, and to determine proper allocation of costs between users and communities.

SHORTLINES

► Air France will begin Boeing 737-320 turboprop service from Los Angeles to Paris via Montreal on a twice-weekly basis and from Chicago to Montreal and Paris three times a week in early April. The French carrier already began daily Sunday transatlantic 747-320 service from New York to Paris. By the end of 1960, Air France expects to have 17 Boeing 737-320s in service.

► Alcoa Airlines has started construction on a new \$7 million headquarters building near the new Honolulu International Airport. The airline hopes to move into the new 140,000 sq. ft. building from its present office in downtown Honolulu by Dec. 1.

► American Airlines reports its fleet of Boeing 737 turboprops had carried over 685,000 passengers 1,574,000 en route passengers in the first 25, one year after its inauguration of 737 service. Of the 685,000 passengers carried, 238,900 were flown over the New York-Los Angeles route which showed a Jan. 25 reported load factor of 83% for the first year ending Jan. 25. American service also coincides with 45 daily 737 flights.

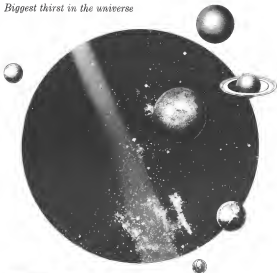
► British Overseas Airways Corp. plans to start daily nonstop London service from June 13 using de Havilland Comet 4 turboprop aircraft. Current New York-London service operates four times a week and will be continued.

► Irish Tourist Office has announced that a \$7 million airport will be built at Ballygarvey, four miles from Cork City in southern Ireland. The new facility will have dimensions 4,500 ft long and 1,500 ft long, both of which can be lengthened as the need arises. Construction has been set for early 1961.

► Sabena Belgian World Airlines last month inaugurated the first transatlantic service by Boeing 737-320 jet service by a foreign flag airline. Sabena began New York-Brussels service Jan. 24, offering at least two weekly round trips and a 96-passenger, 14 first class and 82 economy class.

► Trans World Airlines will begin Boeing 737 turboprop service to London and Madrid on May 16 with three flights a week. The flights will originate in New York and fly nonstop to London and on to Madrid. The new service will bring to the carrier of flights TWA's will offer to the Iberian Peninsula. The airline currently has three Lockheed 369 Constellation flights weekly in service on this route.

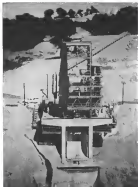
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Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,340 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build lightweight space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems.

Dr. Henry Petroski, Chief, Structures Section, discusses wire and fuel flow requirements for space vehicles with
Donald W. Douglas, Jr., President of **DOUGLAS**

MISSILE ENGINEERING



ONE of a series of Polariss test vehicles is launched from its Cape Canaveral, Fla., Missile Test Center pad. At right is the Lockheed Missile and Space Division's dynamic test stand at Santa Cruz, used to test Polaris under simulated flight conditions.

Lockheed Trims Polaris Vehicle's Weight

By William S. Reed

Saneyville, Calif.—Recent fully-guided flights of Polaris missile test vehicles over the Atlantic Missile Range, which attained 700 mi. range indicate that the goal of 1,200 mi. range may be met by the end of this year, Lockheed Missile and Space Division officials believe.

Range increase will be achieved mainly by an intensive weight reduction program which will trim the fat from Polaris from an overweight test configuration to operational trimweight. Weight from inaccurate light test articles will be cut results in the use of best shields and rationally over-designed subassemblies.

Range objective scheduled for 1962 under the original development program was 1,500 mi., but when two years were slipped off the program at Navy insistence due to unavoidable complexities, was a reduction to range. Ultimate, 2,500 mi. goal will still be met, perhaps considerably sooner than



LOCKHEED technicians prepare controls and data recording equipment for high-g loading tests on a Polaris vehicle. Equipment contains a dynamic load applicator to adjust test



INTEGRATION sections for Polaris test vehicles are shown on the production line at a small industrial scoring machine plant at Lockheed's Sunnyvale, Calif., facility. A total of 47 Polaris vehicles have been launched with 11 shots fully successful.

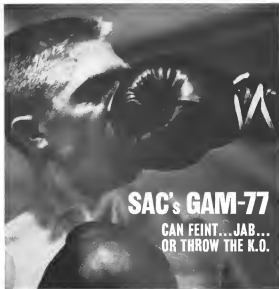


GUN changed by compressed air flow small Polaris components into the air field as part of a shock and acceleration test before actual submergence on the vehicle. The gun compressor, was part of design development for liquid oxygen component packaging. At right is a 30 x 10 ft. gamma used for water tests of Polaris stages. Wave generator produces underwater bursts.



CONNECTIONS on a 25,000 lb.-capacity dynamic load applicator are checked out by H. C. Coen, Lockheed environmental test laboratory engineer. The device can be prepared by a type resembling of lead lattice and stress which the test vehicle will undergo during the actual launch and flight. At right, Lockheed technicians construct a wiring test on the instrument section prior to installing it





SAC's GAM-77 CAN FEINT... JAB... OR THROW THE K.O.

GAM-77 BOUND DOG air-to-surface missiles give SAC's B-58G intercontinental bombers the versatility of a change in boxer. Even while the aircraft carrying the GAM-77 missiles is airborne, a new target can be selected. This reaching out at supersonic speeds after launch, the GAM-77 can flatly assert: for the bomber to deliver its own Sunday punch... or independently destroy the primary target. These jet-powered missiles vastly increase the strike power of the giant Boeing B-52... give it a triple-punch capability.

Guided by a self-contained inertial auto-pilot—set before launch by the B-52's crew—the GAM-77 can't be jammed, can't be dogged. The GAM-77 Head Dog was designed and is being produced for the USAF by the Missile Division of North American Aviation.

MISSILE DIVISION

NORTH AMERICAN AVIATION, INC.

Downey, California



the end of 1962. In a continuous process of refinement and development of ideas, the intense operational drive set in the end of 1960.

Secrets and reliability, rather than range, are the goals presently sought in the Polaris flight test program.

Test Highlights

Highlights of the test program which has brought Polaris to its present state of development and which will provide the background for increased capability are:

- Underwater tests on scale models and full size dummy shapes. The launch tests have resolved basic problems and are being continued mainly to refine the underwater launch technique.
- Integrated or combined vehicle tests. Starting with extensive tests of individual components and subsystems, two or more components or subsystems are tested together not only to establish operation and reliability of each, but to check their operating interrelation.
- Static firings of complete assemblies on a "soft" test stand. Impact results in those which will be presented to the missile's autopilot and guidance system during flight can be simulated on the soft stand because the entire assembly can be displaced while the Avco-General rocket motor is firing.
- Sweeping laboratory tests aboard the USS Observation Island. Moored in San Clemente Island, the ship can perform all operational functions of a Polaris mission with the exception of underwater launching.

Underwater Tests

Underwater tests of 1/4 and 1/2 scale models at the Lockheed Underwater Motion Facility (LUMF) have brought the underwater launching tests of full-scale dummy shapes at San Clemente Island and at San Francisco Bay, continue to provide data which Lockheed says gives the underwater launching of Polaris in a known environment. The underwater tests started at first that the vehicle would handle on its own.

Polaris Box Score

- Total flight time, in and out of inventory 47. Of this, 34 has been classed in fully successful, 14 as partial successes and two as failures.
- AXS tests (conducted so far include eight firings with operational Polaris configurations).
- Earlier AXS tests encompassed 17 firings between September, 1958, and September 1959. Each successive AXS firing approached closer to operational type.
- Prior to this, there were 27 test firings of various making tests to explore design aspects such as propulsion, structure, and guidance.



MEMBER of the Lockheed environment test stand prepares a Polaris instrument section for a dummy load test. In background is a telescope scope for calibration, and a camera.

to the surface, unless guided by fins or coddies. Both full scale and model tests have dispensed the necessity for underwater control, because those characteristics of external configuration which make for good acoustics apply equally in contributing to good hydrodynamic characteristics.

Early in the test program it was thought that the missile might have to be completely encapsulated for underwater launch or be equipped with a plastic overcoat or possibly protected by some sort of dummy structure. Original considerations led to critical test times were the rocket motor and jet area which must not operate after being exposed to sea water. An other doubtful was the differential between chamber pressure and decreasing external pressure in the water column, possibly causing problems with ignition.

But tests on instrumented dummy shapes launched from a submersible modified Argonaut made longer off San Clemente Island on difficulty in order of these tests. Visibility of scale model tests in the underwater tank has been substantiated by the full-scale dummy launches. Scale effects similar to those experienced in wind tunnel model tests have proved to be readily identifiable.

The tank, recently has been completely enclosed so that it can be pressurized to simulate launch conditions varying depths. Scale model tests run in the tank are providing more valuable data than full-scale tests since sea states up to hurricane conditions could be controlled in the model tank.

Effects of pressure against the raw steel under surface during underwater launches from varying depths have received major attention in the tank. Inherent rigidity of the rocket motor case, coupled with the inherent load resistance of the solid propellant grains, provides sufficient strength. Between sections connecting the first and second stages, and the forward engagement bay, sections ahead of the second stage, the air, built in rugged specifications, to provide necessary strength. Both structure and equipment support structures are built from heavy gage steel (up approximately 1/2 in. thick).

Launch Technique

Structural rigidity also is derived by the rigorous equivalent of the launching technique during which Polaris is ejected from the submersible tubes by compressed gas. Missile does not fit snugly into the base of the tube; full compression is maintained by "rod" which allows a "push rod" effect in creating a seal.

A double advantage is achieved in having the base of the tube larger than the missile diameter—natural friction is increased during launch and some far growth in airside diameter is provided to launch the several 100-ton operational weapons of a submarine. Polaris test officials say that criteria for launching a missile does not differ greatly from that required for a torpedo launch. Similarly, it is that continuous air flow, not water, must be removed before the first control computer will allow the vehicle to be

freedom of the gas-turbine launch (rocking) technique of the 35,000 lb. Polaris has already been demonstrated in launch tests of live missiles from a hydrocathode operated ship motion simulator at Cape Canaveral.

Before live Polaris vehicles are fired in the test program from aboard the seventh commissioned submarine USS George Washington (SSN-598, Dec. 7, 1971), damage calculations will be made for final shutdown information in the submarine's fire control system. Crew training will also receive a final shake-down with Polaris damage.

Static Firing

Destructive static tests are conducted with complete Polaris vehicles on a soft test stand located in the Santa Cruz mountains near Los Angeles. Designed to give the missile a slight degree of freedom, the soft test stand is used to check guidance system, autopilot, thrust vector control, thrust termination, ship separation and other subsystem performance parameters. While the rocket motor is firing, deluge water falls from the vehicle in a display, providing both quantitative and qualitative operational data.

Static firings are conducted with telemetry and also with "hard" wiring affording a closed loop connection between the Polaris test measurements and data recorder. This double check provides accurate calibration of the telemetry for subsequent damage fire-flight tests.

Ship separation, always difficult to achieve, is another function which

Lockheed is able to check on the soft test stand.

Explosive separation is used in Polaris but explosive tests are not completed, as in other vehicles.

Static operation of the solid-propellant first stage motor is a critical test item since there is no time for the traditional approach which allows for gradual thrust buildup and a last second check of motor operation before liftoff. Thrust buildup of solid-propellants is almost instantaneous with ignition as compared with the more gradual thrust buildup of liquid-fuel rockets. Test results show that Polaris does not surge as it emerges from the launching tube, but continues to accelerate into the potential position of the flight.

Second Stage

Solid-propellant rocket motor cases and nozzles are not accessible on a flow test, so liquid fuel engines. A second stage could be cut into a case, and the two sides connected, but a "redesign" motor would not have acceptable reliability. Building in the quiet, accuracy, so without repeated firings would accept static considerable refinement in manufacturing methods and materials, and cost savings would be cut off proportion to the savings that might be derived through the reuse of the cases and nozzles.

Cooking live first and second stage cases during static firings is no problem despite the absence of a shipboard. Propellant gases are cut around a steel shaped manifold running lengthwise through the grain. Burning occurs naturally from the inside out and since the



MOTOROLA Military Electronics Division



Specially designed Polaris slapping and storage machine is shown to William S. Reed, Assistant Vice president, in E. C. Carr, of Lockheed. That is used for static tests.

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FOUR DOW PLANTS OFFER AIRCRAFT AND MISSILE MEN WIDE CHOICE OF MAGNESIUM WARES

Coiled sheet, thin wall castings, many other production items are now available from Dow's big rolling mill, foundry and fabrication facilities.

Aircraft and missile manufacturers on the alert for improved materials and production methods would enjoy a personal tour of the four Dow plants that turn out magnesium products. Next best thing to this quick rundown on the new ways of forming and fabricating magnesium now being practiced in these plants to open up new uses for the lightweight metal.



ROLLING PLATE runs hot, is annealed by electrolytic reduction process.

At the huge Madison, Illinois, rolling mill, for example, they're making magnesium sheet that doesn't require stress relief after welding. This is a major step forward in light metal technology and is born to manufacturers using magnesium assemblies. Madison has also increased the maximum width of sheet to six feet. Five different sheet alloys, including elevated temperature alloys, are now available either flat-in-coil.

To keep ahead of the rapidly increasing demand for precision

pipe and forgings, Madison keeps a close watch on the tolerance of Dow magnesium casting alloys. Typical distance tolerances, for example, are 0.010 inches in any six feet. This means greater accuracy and less machining for users of Dow casting plate. Madison is now turning out both magnesium and aluminum extrusions that cover a wide range of sizes: from delicate precision parts to a 30-inch extruded pipe made by Madison's mammoth 13,000-ton extrusion press.

Over in Bay City, Michigan, interesting things are happening, too. At the well-equipped Dow magnesium foundry, largest in the U. S., sand and permanent mold castings of all sizes and shapes are being produced on a volume basis. Complete facilities are maintained for heat treatment, stress DMI impregnation and chemical treatment. A well-staffed quality control team makes sure that all specifications are met or exceeded, and that the most modern equipment and techniques are fully utilized.

The Bay City foundry casts many complex and difficult designs. Large castings with walls as thin



DOW FOUNDRY offers products in shapes for sand and permanent mold castings of all sizes.

as 0.100 are now being produced. Other useful developments include cast-in tubular passageways for use as hydraulic lines, special coring techniques for casting enclosed shapes, and new magnesium casting alloys.

A new die casting plant is now on stream at Bay City. This facility houses the most advanced magnesium die casting equipment, including cold chamber casting units which automatically feed metal to the machines and contribute to unusually high production rates. To assure close alloy composition control, as both die casting plant and foundry, a direct reading spectrometer provides frequent and precise analysis of the molten metal. Similarly, X-ray equipment is also available where radiography is needed in quality control.

The Dow fabrication plant, also in Bay City, offers capacity for value work on magnesium assemblies. Here, too, developmental work on magnesium is constantly in progress. The plant is set up to handle large or small jobs, and plenty of both. Its activities include deep drawing, bending, spinning, stamping, piercing, machining, arc and spot welding, assembly, chemical treatment and painting. This plant has pioneered many "firsts" in magnesium production, such as hot drawing, spot welding and automatic welding.

For more information about Dow's extensive product facilities, contact the nearest Dow sales office or THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Manufacturing Department 100432-8.

rate of burning is greater than the rate of heat transfer across the grain, an burned propellant actually serves as an insulator for the core. Test engineers say that the core could be only slightly warm to the touch during a run and immediately after burnout, but will build up heat gradually after the propellant is expended. Strike tests have proved that heat shielding between fire and second stage nozzles is not critical.

Life-cycle tests are conducted on each individual component in the first step in the combined system or integrated test program. These individual tests form the basis for a "Christmas tree" or pictorial of the structure, which is the framework of the test program. Combined tests are run as components in pairs with particular emphasis on their interrelation. Point of contact between the two, whether it is an electrical or mechanical connection in the structure between first and second stages is referred to as the interface. As the pairs of components are qualified in combined tests, two parts will be subjected to combined tests and this program continued until testing of last assembly is reached.

Test Economies

Development of test equipment for Polaris is a matter of dollars versus seconds. Specifically tailored equipment has been developed only when more rapid test conducting is needed.

One such piece of equipment is a water-bath test chamber capable of cradling in a pressure equivalent to 100,000 ft. altitude and capable of maintaining temperature ranging from -65 to 1000F. Internal capacity of the chamber is a tube enclosing four feet as each rack.

Also, evaluation of temperature and pressure can be placed in the rig which load assemblies to completion. This automatic control of test conditions. Dynamic and static tests are used which permit exact load factors as needed in test vehicle flights to be generated in ground tests so that substructure can be studied under realistic conditions. Power source for one such capacitor is a 25,000 lb. amplifier.

Since tests designed originally for development purposes have proven so satisfactory that they are substituted on production from a quality assurance test.

One example is the arc relief, or popgun, test used to cut the air lock device which prevents hot stage ignition until conditions of acceleration, time and environment have been attained. Popgun tests simulate the acceleration and shock of the progressing launch from the submarine outside tube. Since the popgun test is non-destructive, with the interlock packages



Mercury Capsule Fitted With View Ports

Four new high temperature glass and in Mercury capsule view ports (AV No. 25, p. 21) that extra glass shaped to capsule contour. An space between ports fitted lead transfer. The glass was developed by Corning Glass Works.

Being sought in a suit, it has been constructed for routine checks at each production run.

At one time, Lockheed considered movement of a standard test substructure to include at least one Polaris launch rig tube. Request for the test substructure are strictly limited for a time but abandoned when it was determined that the cost of test a conversion could have been too great. Navy and Lockheed decided that the launch would be more readily applied to the operational substructure.

Lockheed officials credit the integrated test program with being the main reason for the Polaris development program could be cut from five years to three. These combined system tests have progressed at rates which allow completing along the development curve to show that Polaris will become operational by the end of 1960 instead of the end of 1962.

Also under test is Lockheed's a 16,000 lb. aluminum container designed to transport a fully assembled missile. Container is prepositioned, heated and de-iced, and needs only the application of external electrical power to maintain an environment suitable for the temperature sensitive propellant.

Other contractors, designed to carry the missile in smaller substructures also are under development.

Practice for last time to day the parts for last test assembly at Cape Canaveral, Fla. or at the Naval Weapons Areas, Charleston, S. C. which will be the storage and launch site when Polaris becomes operational late this year.

For example, first and second stage motors are delivered by Aegion complete except for last external part tag.

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Largest Facility in the World for Polypropylene Composites Manufacturing

George V. Allen, director of the U. S. National Aeronautics and Space Administration, recently presented a bold reconstruction of the impact Soviet space programs have had upon U. S. allies and ultimately the world-hat to U. S. prestige and the "national defense image" of the United States. Allen's presentation before the House Science and Astronautics Committee, Mr. Allen said that "regardless of class," Americans are first and foremost Americans and that, as such, it is the role of the U. S. to give space to all free men and technological capabilities to the world, thus not falling short of our own capabilities of an American commitment to modernizing the world to the rest of the world, thus the nation's role in the United States today. We cannot afford to let the Soviet Union have a lead in the development of space technology for the development. Our own domestic debate helped make the Soviet advancement more even more significant, and needed to put the whole matter into a framework of U. S.

34. *Tristramella*, highly colored green and

George V. Allen, 54, director of the U. S. Information Agency since November, 1945, had been a member of the Foreign Service for 25 years prior to his appointment, including time as U. S. ambassador to Czechoslovakia, India and Iran.

Mr. Adams, who holds a master's degree and the Charles Seaver Prize in International Relations from Harvard University, also has held the position of Assistant Secretary of State in two administrations and during one of those times headed the overseas information and cultural activities of the U.S. including the Voice of America, radio broadcasts and the press, literary and cultural relations work abroad.

A specialist in Near Eastern and Asian affairs, Mr. Allen attended the World

War II. Carlo conference between President Eisenhower and Prime Minister Churchill, the 1949 conference which wrote the U. N. Charter in San Francisco and the postwar Truman-Churchill-Stalin conference at Potsdam. He was chairman of the U. S. delegation to the UNESCO conference at Beirut in 1946 and at Paris in 1949.

solid treatment of quasi-rational pure π - π to more sophisticated judgments and more balanced actions. The sublime change, as helped greatly by our success in leeching a mass of ardors and obtaining information from them, though our payoffs were of a lower magnitude than those of the Street House.

U.S. also begins to see worldwide accord which pointed out the difference between American openness in letting the world in on our future as well as our successes and Soviet desire to announce attempts as well as achievements.

During a 17-month period following the first Sputnik, we again stressed that the United States deeply resented espionage. At the same time, the prestige that accrued Soviet achievements also conduced to realism, to our recognizing of Sputnik did not approach the commanding position that we had enjoyed before Sputnik. Furthermore, our failure to spend Soviet accomplishments to force the world into an anti-Soviet alliance in placing ever higher prices on orbital space made the Soviet program less easily resented.

For a period of many months, the prevailing world opinion seemed to anticipate a kind of détente, with first the U. S. and then the Soviet Union accomplishing some noteworthy activity. This was accompanied by some hopeful opinion that the U. S. would curtail the Strategic Arms Limitation Treaty negotiations, and so on.

11008 Saccuman, H. S. Poljan

Then came the two dramatic and accurate forecast season charts follow by the futures of our own. As a consequence of these, events, the success seems to have tipped solidly in the North direction, as would appear. Today, although we continue to see the huge, expressed demand that the U.S. will catch up, we also are growing doubt that this is likely during the next five or even 10 years.

Except for the most dramatic of space events, the world press now is less inclined to give startling headlines to every day event. At the same time, general news interest in space has grown steadily, as both screenplays and depth of coverage—and along with that has been a surge in interest in all aspects of science and technology. Here the United States has an advantage: the world's greatest accessibility of our research and our general willingness to share our findings with others.

However, we note an increasing tendency toward what the Soviet Union calls *desert*. There seems to be a prevailing view that the first step must be to leave the Soviet Union. We have seen very close, intimate trade relations, that American, looking at the same, will find Russia there. In other words, the great outpouring of American achievements in space are so known in evidence. Soviet

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Digital readout of a high-accuracy, transformer protection electrical system.



Sub-system for the ground support equipment in the 10-15 minute program. Because of our design, control relays, and safety, and all of the other 4 relays are built into the system for its essential control and data processing.



Resistor measuring system - built as a modular device to allow scaling, and other components required for scaling, stability of multi-turn potentiometers.



Multi-channel digital recording, and recording system measures all 100, 100, 100, and 100. Many and many other systems for multi-channel recording and control.



Resistor measuring system - built as a modular device to allow scaling, and other components required for scaling, stability of multi-turn potentiometers.

Systems shown here are typical of more than 200 designed and built by EI and now in use. They range in complexity from data logging systems for automatic recording, measurement and recording of data from multiple transducers, to high speed, automatic, electronic systems for analysis and control... to give me for automating industrial processes.

Because of the EI modular design approach, many of these systems can be delivered on virtually an off-the-shelf basis, eliminating the long delivery times usually associated with custom development. This approach also results in a low cost system because the modules are manufactured in large quantities. Cost is about a lower fraction of performance capabilities desired.

you get **MORE** with EI systems!

MORE VERSATILITY

AC and DC voltages, AC and DC voltage relief, pulse resistance capacitance, frequency phase, resistance, time, or combination of these basic input quantities can be accepted by the EI system.

MORE RELIABILITY

Minimum use of state-of-the-art and MIL-type components which are designed into custom-built circuit, field-proven circuit. All vendor-supplied parts are extensively tested and evaluated.

MORE FLEXIBILITY

Expansion of the EI system can be made by simply adding appropriate new modules. This approach eliminates new engineering development costs each time needs change, minimizes system obsolescence.

Why not talk over your digital system requirements with your EI Sales Engineer? His system experience will be a valuable help in solving your problem.

Electro Instruments, Inc.



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FRI

thinks
'em
up!



Thinking up solutions to the problems of space tracking is but one phase of FH's work in fast food transfer. GSE applications include handling of nuclear isotopes, composites, and exotic fuels.

Solving the unusual problems is a specialty of the house. Whether your project requires design, manufacturing, testing, or plant "thinking up answers", FH is the team to call on... write.



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space technology widely accepted. The importance of the spacecraft as a weapon. The world lives in both America and the Soviet Union with new eyes today.

'Revised Soviet Image'

Probably, the most significant result of the Soviet success is a change in the world's impression of the people of the world about the Soviet Union. In public opinion surveys, we speak of the "cold war" and "cold war" image. The change goes beyond the field of space technology. It covers all of Soviet science and technology, plus Soviet military power and general standing.

But, Sputnik II has made the Soviet Union not only a power in the world but also a power in the world. It is a power in the world of science, technology and production. Now, the Soviet Union is able to challenge America's power in all these fields, including mass production.

It is fairly as unrealistic to say that space has become for many people the power symbol of world leadership in all areas of science and technology.

Soviet science and engineering students are being attracted to the Soviet Union for this reason. Soviet technological and industrial experts are getting a better reception than in the United States. Soviet scientists are being awarded greater prizes, are speaking with increased authority and are being treated in more abundant ways. One technology and perhaps the greatest effect of Soviet success in space has been the new confidence it has lent to Soviet claims in other fields. Before Sputnik, most Soviet scientists were usually dismissed as propaganda. Since Sputnik, there have been less such dismissals.

Prime Minister Khrushchev, in a speech at Krasnodar on Dec. 9, 1957 following his return from the U.S., said this statement: "The American now finally admit that they have lost the Soviet Union in several most important fields. Until for instance I read a statement in American Congress Minutes and of the chief technical and industrial minister of the United States. He also said that the Soviet Union ahead of space program, the United States could lead there in five years to catch up with us, or to overtake us. This is a valuable and credible admission."

'Principal Danger'

The principal danger in the situation seems to us to be the confusion which has occurred here concerning the Soviet officials themselves. If it were a question solely of competition in scientific achievements as one could properly suppose the Soviets might not be so confident. They might not be so confident regarding their scientific progress. Nor should one imagine that the Soviet Union is at all confident. Most foreigners who visit America during the first half of the century often found one of the first signs of confidence in the Soviet Union during the first half of the century. However, if the new found Soviet scientific progress, it is not too long a road to the world's scientific achievements as formerly often the world is so for a good deal of trouble. Even though Soviet officials themselves have previously sought to prevent their space

program as powerful and desirable, the world's public reaction has been to read into space activities a military, imperialist. Premier Khrushchev's statement that the USSR has now shown that it can hit any spot on the earth's surface, based on this in an editorial in the Soviet newspaper *Pravda* on Sept. 14, 1959. Commenting on the Soviet success in having the moon, this editorial declared: "... now we know that an H-bomb-carrying rocket can, with precision, hit New York, London, Moscow, etc., also on Sept. 14 (and) "If we had in doubt before, now we know that, for the world, there is no doubt. Now we can make sure that a threat to the U.S.S.R. will automatically mean that it is a threat to the world."

Obviously, to maintain this confidence in us we must keep ahead separately with space exploration.

Many people of the world are showing growing concern over the potential military dangers of an unbridled space race, and there is widespread concern over the need for international agreements to assure that space will be explored for peaceful purposes only.

'U.S. in Space Race'

All space activities are now seen within the framework of Soviet-American competition. Regardless of how Americans may feel about it, the world sees the U.S. in a space race with the USSR. Recent Russian attacks on internationalism as such activity is a helpful development. Many international scientists in space will tend to regard space people as internationalist.

In summary, I would like to respond to the statement's specific question as the importance of space progress now here in a little in international relations world progress and in the minds of people of other nations? By indicating that we space progress has a significance beyond the field of the technical itself that it bears on almost every aspect of our relations with people of other countries and on their view of us in comparison with the USSR. Our space progress may be considered in a sense of our vitality and ability to compete with a formidable and as a measure of our ability to maintain technological competence worthy of attention to other people.

Second Kiwi-A Ready for Testing

Las Vegas, Nev.—Preparation has begun for field experiments with Kiwi-A Probe, second in the Project Rover series of experimental nuclear rocket experiments.

A team of Los Alamos Scientific Laboratory experts is at the Atomic Energy Commission's Nevada Test Site here to test the pre-launch for test operations. Kiwi-A Probe experiments are scheduled to start this summer. The experiments will actually conduct three test runs and will occur in Nevada. Heading the group will be Keith Bayler, Kiwi-A Probe is the successor to Kiwi-A, the first rocket motor in the



To track
in trackless
space...

Philco has designed and built the world's largest 3-axis tracking antenna

The world's largest 3-axis tracking antenna was recently completed at the Philco Western Development Laboratories in Palo Alto. It will be used at one of the world-wide satellite tracking stations to receive vast amounts of scientific information from outer space. By employing the unique design feature of 3-axis mounting, the extremely accurate and complex instrument, designed and built by Philco, has complete flexibility of movement and can provide continuous coverage of unlimited information and data from satellites and missiles during any phase of flight.

At Philco you will find the staff that comes from close involvement in the world-wide problems of planning, developing and implementing advanced space communication programs. Experience that includes the design and construction of antennas of many types. Each fully meets the stringent specifications of the military and various scientific research organizations. Philco consistently fulfills your specific needs.

PHILCO CORPORATION/GOVERNMENT AND INDUSTRIAL GROUP
Palo Alto, California

Communications and Weapons Systems Division
Computer Division • Space Electronics Division
Western Development Laboratories

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The Philco 3-axis antenna stands 60 feet high and weighs over 150 tons. One of its main support columns is 10 feet wide. It is a solid aluminum plate fabricated by electroforming in a thickness of 45/1000 of an inch. Its entire surface is ground to mirror finish under the most exact manufacturing conditions. The antenna weighs 40 tons and is able to rotate up to 10 miles per hour and its mechanical efficiency is nearly up to 100 percent per hour.



Test Chamber Simulates 100-mi. Altitude

Altitude of 100 mi. is simulated in environmental test chamber at Army Signal Research and Development Laboratory Ft. Monmouth, N. J., where altimeter sensitive parts for missiles and satellites are checked out. Satellite instrumentation is shown to be tested alone.

Rover tests, which began missile operations last autumn (AW June 29, p. 38). Prime will look much like the original Kollsman, but internal arrangements and components will be different. Los Alamos now is making dual elements for the motor. The shell and some of the internal components are being made by ACT Industries, Inc., of the corporation's South Albuquerque, N.M. ACT Industries also operates the disassembly box of the Minuteman, Arrowhead, and Dromedary.

Building in the Rover Area at Idaho Falls.

Hydrogen for Kin-A Prime experiments will be supplied by National Aeronautics and Space Administration sponsor with AEC at Project Rover. The hydrogen facility will be operated under contract by Air Products Inc., Rockledge, in fabricating the parts, as it did for the earlier Scout, Edgemon, Comanche and Gen. Inc. will continue to provide and operate instrumentation.

COSPAR Plan for Advance Data On Space Launches Has Loopholes

NASA, France-Agencies in supply advance worldwide information on space satellites and space probe launchings were among 1400 after meetings here of COSPAR's working group on data and coordination.

Members countries of the Committee on Space Research at the International Council of Scientific Unions agreed such launchings should be announced "within hours" after a successful shot, but left loopholes in such commitments to supply pertinent information.

One of these, future satellite launchings could not be announced in advance unless "in the judgment of a launching nation" there are significant changes in time, frequency, frequency, orbital elements or other characteristics.

Communications among the future constellation of flights will be in the Spaceways network, comprising the Satellite Regional Warning Center (SRWC) in Darmstadt, Germany (Code 0000000000), Moscow USSR (Code 0000000000), Tokyo, Japan (Code 0000000000).

and Washington, D. C. (Code 0000000000). For some time, it is said, with data will originate either in Russia or in the U. S. go first to other Councils or Agencies and then be circulated to the other centers.

Specimens also should be used for measurement of successful launchings after the flights and for distributing satellite orbital elements periodically, and on a current basis during the useful life of the equipment, the group recommended.

But for the space probe, COSPAR has suggested that the launching group make precise arrangements with the specialized stations capable of capturing and tracking of the probe so that the operation data can be transmitted rapidly. This provides another loophole according to some observers, because no country can claim that such as a tracking facility can really handle the operation.

While such progress was made in COSPAR during its working sessions

that paralleled the First International Space Symposium last, the coordinator suffers from the problems that plague any international organization without both.

Such an organization can accept most procedures, but without the power to enforce them, international cooperation becomes a matter of a flag and of member nations to cooperate.

One example of the problem is in the advance warning of satellite launchings. The U. S. has agreed to make preliminary information for all future National Aeronautics and Space Administration satellite launchings available to all countries in COSPAR. But the Russians have not agreed to publish their shots in advance. Several nations are used to do so because orbital inclinations and trajectories characteristic of their various Sputniks have remained unchanged.

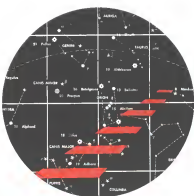
This is true as far as it goes, but it should be noted that there are generally accepted orbital elements which define the position of a satellite. For the Russian satellites, only one of these—the orbital inclination—remains constant.

The Russians earlier made a formal complaint through their Academy of Sciences that no orbital data on the American Discoverer satellites was made available to Soviet scientists, who were especially interested in public affairs. But U. S. scientists answered the protest by emphasizing that Discoverer shots are under the Department of Defense and were not part of the experiments made during the ICG and ICG program.

Dismissing the COSPAR, meeting pointed out that Russian announcement of possible future impact areas in the Pacific was made before that country had accepted, in its presence, the programmatic basis, the basic concept of COSPAR as an international agency for cooperation in space science. They observed still wondered whether that announcement was made as part of a general desire to cooperate or as part of the long-term geo-political warfare ploys that has gone hand-in-hand with Russian space achievements.

Third X-15 Flight-Test Checks Skid Landing Gear

Test proved flight of the No. 5 North American X-15 aircraft took place the plane to an altitude of about 55,000 ft. and speeds in excess of 1,600 mph. The test purpose was to check out the skid landing gear, which functioned normally in a 200 mph touchdown. Design means now has been established that 740,000 lb. The aircraft will have a speed capability of 1,600 mph, observers due to the project believe.



kollsman

From inner marker to outer space

"What's my Kollsman number?"

Ask any veteran pilot. As he approached the field for a landing, he would make the control tower was a matter of habit—his "Kollsman number." Then, as a matter of course, he would make the correct setting on the Kollsman altimeter in front of him.

Over time the Lindbergh era, the flying world has known Kollsman. And Kollsman knows the flying world. Today, there is a Kollsman instrument aboard almost every known aircraft. Often more than one. Usually a complete system.

From the first sensitive altimeter designed and manufactured by Kollsman back in 1922 to the Kollsman Integrated Flight Instrument System of today, Kollsman has led aviation's rapid advances in instrumentation.

For prop flight... Kollsman produces a complete line of flight monitoring and control systems ranging from true engine indicators and engine instruments to automatic cabin pressure controls.

For jet flight... Kollsman produces fully integrated flight, navigation and turbine monitoring and control systems capable of coping with split second problems—from take off to over 100,000 feet.

For missile flight... Kollsman produces equipment from the ground up—from Ground Support Equipment to environmental components, instruments, and space navigation systems.

For 32 years Kollsman craftsmanship has established a standard yet unequalled. Kollsman is synonymous with quality and precision in flight instrumentation. That's why it's so—

If It Flies, It relies on Kollsman

**from heavy bombers
to Hound Dogs
kollsman
STAR TRACKERS**

Altitude 40,000 feet. A B-52 on a mission. Slung under each swept-back wing, waiting on streamlined pylons, are poised two deadly Hound Dog missiles.

A tiny transparent dome barely protrudes above the top skin of the bomber. Two more peep out from the forward tips of the pylons. Three eyes in all. The eyes are Kollsman astro trackers, each locked on a star.

One guides the bomber. It's a Kollsman automatic celestial navigation system. The other two will give faithful commands to the missiles, if they must be launched.

Navigation in space—This advanced automatic celestial navigation system was conceived, researched, developed, and crafted by Kollsman. It is being used in classified missile programs. The basic system is also operating aboard the B-58 Hustler, in bomb navigation systems, and in submarines.

The Kollsman automatic celestial navigation system is not just an R&D project—the system is in quantity production. Designed for today, it is proof of Kollsman's "space" capability. A very real one. For space navigation requires the ability to track sun, stars, and planets...to triangulate automatically, precisely, with high accuracy.

Kollsman systems have tomorrow's ability—today.

Truly, if you fly, you rely on Kollsman



kollsman systems free

Mach 0.9. No time to compute true airspeed. In 6 seconds, the ship has shot forward a mile...too fast to figure.

But with KIFIS*, instrument readings are automatically corrected and computed, integrated in a familiar display. The pilot concentrates on just one function: decision making.

KIFIS is one of a generation of new flight systems.

Another advanced flight system is the new Kollsman Takeoff Monitor. Jet takeoffs involve instantaneous headline decisions because of the jet's constant thrust characteristics and its relatively slow acceleration. From the instant he begins to roll—all the while he is roaring down the runway to gain flight speed—the pilot can check his Takeoff Monitor and know every instant the probability for a safe takeoff!

*Kollsman Integrated Flight Instrument System

FLIGHT INSTRUMENTS

- Altimeter Indicators • Director • Gyro • Mach • Maximum Allowable • Heading
- Altimeters • Sensors • Dual • Director • Fuel • Fuel
- Angle of Attack Indicators and Transmitters
- Angle of Yaw Indicators and Transmitters
- Total Altimeter and Differential Pressure • Data
- Differential Pressure Gauges
- KIFIS—Kollsman Integrated Flight Instrument System
- Fuelmeters
- Takeoff Monitor
- Roll-Over Speed or Rate of Climb Indicators

ENGINE INSTRUMENTS

- Engine Tachometers Indicators • Generator
- Pressure Ratio Indicators and Transmitters
- Oil Pressure Indicators
- Manifold Pressure Gauges
- Speedmeters

NAVIGATION INSTRUMENTS

- Compasses • Magnetic • Azimuth • Direction Indicators • Sky
- Synchronizing • Magnetic • Photo • Photo • Photo
- Photoelectric Tracking Systems • Star • Star
- Computing Systems to provide data to automatic celestial navigation

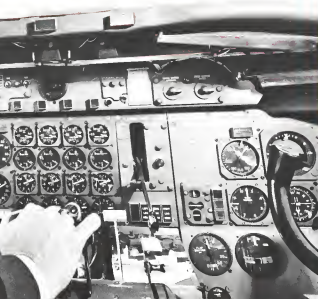
(Photo—Flight and engine instruments available in different layouts as required.)

the pilot for jet flight decisions

Both KIFIS and the Takeoff Monitor show distinct Kollsman capabilities for space. In space, the pilot must be able to anticipate where he will be—and what will happen—30 seconds from now. The future must be brought into the present. At missile or manned vehicle speeds, he must take into account the 150 miles that leap by as he looks... as he thinks... as his finger reaches out and flicks a switch.

You can count on Kollsman to provide the space flight instrument system.

Truly, if you fly, you will always rely on Kollsman



Support from the ground up... with kollsman GSE

Kollsman began making "Ground Support Equipment" three decades ago. Sophisticated equipment for its day, it was not called such, perhaps. Technology may change, but not the reliance. Today, Kollsman offers the most comprehensive GSE capability available—anywhere.

Whether the Ground Support Equipment is for our own products, or for sophisticated space and missile programs, Kollsman has demonstrated its capability. Whether involving specifications demand unusual electronic, mechanical, electromechanical, or optical know-how—Kollsman assumes imaginative development engineering, uncompromising craftsmanship, and proved production techniques.

From contact to countdown

Kollsman provides reliable systems backed by a complete service. From simple flight line go-as-go testers to room-filling multi-variable check-out systems, Kollsman assures user confidence.

Kollsman has produced a full range of GSE representing insured applications of State of the Art techniques in electronics, optics, electromechanics, pneumatics—to name a few. These equipments are in reality complete systems laboratories triggered into action at the flip of a switch. Laboratory-proven results are presented unambiguously in analog or digital form.

Kollsman GSE does not end with delivery of hardware alone. Field service teams provide classroom instruction and supervise instructor, technician, and mechanic training. These teams are available whenever—and practically wherever—required.

If it flies, it relies on Kollsman



38 years of experience... unequalled craftsmanship spell unchallenged leadership in the design and production of precision flight instruments, automatic celestial navigation, electromechanical, and optical systems for the aviation industry.

There's a Kollman instrument aboard almost every known aircraft. Proof of dependability. Proof of craftsmanship. Proof of acceptance in a field which can't tinker with chance. Kollman engineering and manufacturing complexes produce precision instruments, flight systems, remote modules, and ground support equipments of unmatched excellence. Kollman leads the world in automatic celestial navigation systems. More than three decades of Kollman specialization serve as a springboard to the stars.



If it flies it relies on

- Astro trackers
- Automatic stars compass
- Air data computers
- Electromechanical systems
- Missile components & systems
- Jet engine instruments
- Flight instruments
- Kollman Integrated Flight Instrument System
- Optical systems & components
- Doppler computer systems
- Sextants (periscopic—handheld—photoelectric)
- Pressure-sensitive controls
- Flight simulator instruments
- Laboratory test instruments

For a complete detailed list of Kollman products, send for illustrated Product List.



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AGENA B satellite test stand complex is located in heavily wooded area. Electronics is central control center for both stands.

Agena B to Put Samos, Midas in Orbit

Savannah, Ga.—USAT-Lockheed Agena B satellite vehicle, featuring a restartable rocket engine, will be used to inject heavy payloads into large orbits for the Air Force's Samos

photographic and Mules infrared detection advanced reconnaissance systems.

The Agena B (AW Doc. 13, p. 18) embodying an advanced Bell Booster engine, is being tested at Lockheed Missiles and Space Division in preparation for launch atop Atlas rockets, scheduled before month's end, after this year. This was revealed at the activation of the 544th Test Wing (Satellite) here by Lt. Col. Bernard A. Schenker, commander, Air Research and Development Command.

Control payloads will be injected by the Agena B before the engine can be shut down after orbital velocity is achieved at the juncture of an elliptical orbit.

Once the vehicle has reached the orbit apogee, the engine will be restarted and the remaining thrust used to achieve a circular orbit starting at the apogee of the ellipse. "This coasting technique will permit a heavier payload to be placed in a higher orbit orbit at practically no expense of energy."

During the seventh test firing of the Agena B engine at Lockheed's nearby State Circle facility, the prolonged 340-sec run of the engine was terminated by the test director after 155 sec when an engine fire broke out. A restart was not scheduled for this particular test run, but Lockheed officials say that the engine has been returned "some time in near maximum conditions" at the Air

Force Arnold Engineering Research Center, Huntsville, Tenn.

One of the principal reasons for the tests at Arnold Engineering Research Center was to find a combination of fuel and oxidizer that would be hypergolic at the very low pressures the vehicle would encounter in space. After a series of tests Bell satellites came up with a liquid propellant combination believed to be unreactivated dimethyl hydrazine, and red fuming nitric acid that was both hypergolic at high alti-

tudes and more powerful than propellant used in original Booster stages.

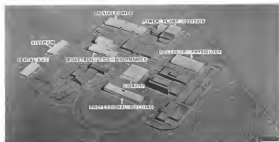
Agena B differs from the Agena A vehicles used in Discoverer satellite orbits in that merely because the A vehicle has almost double the fuel tank. Added space for the narrowed fuel tank was gained by lengthening the vehicle rather than increasing its diameter.

Agena A vehicles weigh 5,500 lb at launch and 1,700 lb after engine burn-out. Double fuel capacity, might being the latest weight of Agena B is aimed



CONTROL center at State Circle includes television displays (top) for component inspection.

AVIATION WEEK, February 5, 1960



EXPANSION program for USAF Aerospace Medical Center's School of Systems Medicine at Brooks AFB, Tex., would cover three deaths prevent facilities. New buildings are shown on this aerial, along with existing facilities. Facilities costing more \$12 million would prevent sophisticated studies of the effects of space environments on humans and animals.

Medical Center Broadens Space Studies

San Antonio, Tex.-based program, more than doubling present facilities, is designated for USAF Aerospace Medical Center at the School of Systems Medicine (SAM) toward a goal of ensuring that U.S. astronauts and space crews will be able to survive and function in the changeless new environment of space (AV Feb. 1 p. 66).

The plan will cost some \$12 million in new construction and is designed to provide needed capabilities fitting the school's mission. The importance of which was emphasized when late last year aerospace medical facilities were elevated to the status of an Air Force Center. The school's command chief, Maj. Gen. Otto D. Berman Jr., commands both the school and the new center.

Future Funding

The \$12 million in funds continues to create planned additional facilities here at Brooks AFB have been authorized by Congress, but just failed becoming an appropriation because of Congressional adjournment in the last session. Berman said it could be approved. Gen. Berman noted it is noted that during a recent visit to the school's San Antonio (30-Ten) and Rep. Paul J. Kilian (D-Tex.) both pledged that they would make special efforts to secure the appropriations during the 1980 Congressional session.

Facilities meeting the appropriation

• **Biomechanics/Biodynamics Laboratory**, which will house a pilot's centrifuge having a 45-ft diameter arm, plus a small complex animal centrifuge, both having a capability of developing 20g forces to provide detailed experiments on acceleration forces that may be encountered in aerospace flight. High vacuum chambers, stainless steel animal capsules and other equipment for space-oriented studies will be provided here.

• **Biomechanics Laboratory**, which along with the Biomechanics Laboratory, is considered by Col. John E. Polking, director of medical research at the School of Aerospace Medicine, to be the two top priorities items in the expansion program. Biomechanics facility will be capable of housing potential hazardous materials as personnel with elaborate safeguards for researches and subjects and the community for much-needed study of radiation hazards in the aerospace regime. A nuclear laboratory would maintain a neutron generator and radiochemical laboratory, a biological laboratory for study of bacteria, viruses and other infectious organisms and their interactions under radiation environments and a toxicological laboratory where research on toxic vapors, fumes, dusts and gases will be studied.

• **Cellular Physiology Laboratory** will provide facilities to develop cellular and molecular research in physical character-

istics, radiobiology, biochemistry, bio-physics, pharmacology, physiology and neurobiology. The aerospace curriculum includes and stresses relating to USAF operations such as pressure, weightlessness, joint vibration, acceleration and radiation will be studied here.

• **Vascular Support Facility** will house a sub-human primate colony, a pig colony and other large animals used in space research; small animals will continue to be housed in the Research Institute at Brooks.

• **Professional Building** will handle all medical records to provide controlled receipt and processing of clinical records including electrocardiograms, radiographs and full clinical records of personnel covered by the School's Directorate of Casualty Services. Here also will be the Biometrics Services Section providing information analysis of experimental data.

• **Anatomical Laboratory** will be designed to collect the most definitive and latest research material on flight and space travel medicine, including bones and postmortem and soft tissue provide tissue analysis services.

• **Dental Research Laboratory** will have the experimental work in three various specialties, including restorative dentistry and oral surgery. The school has begun giving priority responsibilities to USAF's dental research program.

With the new facilities in operation,

it is estimated that the school will be spending some \$18 million annually, in the area on permits and contracts and will be staffed by some 2,000 persons.

Although official figures are difficult to obtain on research budgets, for the school indicates are that it has grown steadily been provided "significant support of Congress. Annual budgets for research at the school have approached \$5.4 million in fiscal year 1982, \$2.8 million in FY 1980 and \$2.2 million in FY 1978, which are far actual research and do not include flight pay.

Gradually, a considerable amount of the school's research is contracted out, with the Brooks facility. For example, some \$2.3 million of FY 1982's research budget was contracted and in-house work covered approximately \$1.2 million.

Approximately half of the number of research projects initiated at the school are contracted to other organizations, such as universities.

Honeywell Develops Space Test Chamber

San Antonio—Detailed studies of aerospace medical problems that may be encountered in space require special facilities for extended periods will be studied in the future using the new Minneapolis-Honeywell two-man space cabin simulator installed at USAF School of Aerospace Medicine, San Antonio, Texas, by Honeywell Inc., St. Paul, Minn.

New to contain chamber, which is expected to be operational in the next six weeks, provides considerable more complex instrumentation and facilities allowing more sophisticated research than has been possible with the school's existing chamber.

With initial emphasis of doubling crew members that can be "sent into space" for prolonged periods, the chamber's design encompasses "flexible" permitting it to be extended to the future, and permitting further increases in the number of crews that can undergo aerospace medical research on a continuous basis. An astronaut, Dr. George A. Bland, professor of experimental physiology, told AVIATION WEEK: This modular concept will provide sufficient area for detailed research on the most difficult problems of aerospace research in the future. Bland said the chamber is designed to operate as well as development of existing missions.

Also possible, with the human crew, will be communications links between the crew chamber and the program crew man chamber.

This will permit simulation of all some such as space platform support and rescue and studies of medical problems involved, he added.

AMC Contracts

Wright-Patterson AFB, Ohio—Full listing is a list of unclassified contracts for \$15,000 and over is released by the Air Materiel Command.

Systems Division 1 total. Aircraft Corp. M5000 from base on immediate order previous work in accordance with contract M5000-2-21, dated Oct. 27, 1980 and an M5000-2-21, dated Oct. 27, 1980 and an M5000-2-21, dated Oct. 27, 1980 and an M5000-2-21, dated Oct. 27, 1980.

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"CLEAN ROOM" QUALITY FOR COUNTDOWN RELIABILITY



ROTHCO High Pressure Rocket Disconnection Couplings, developed specifically for Minotaur and Rockwell, offer the ultimate in safety, reliability, and performance, with such features as:

- Positive self-sealing upon disconnection
- 1000 psi operating line pressures
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There are no moving parts, no vacuum tubes and no transistors in high current mode in the Kinetics inverter. The design features rugged silicon semi-conductor elements that are able to carry heavy current without failure. A serious emphasis has been placed on transistorized solid devices in order to protect extremely sensitive power circuits from short circuits or high voltage transients. The silicon diodes will carry extremely heavy

overloads, including shorts, for several seconds. This is usually long enough to trip the circuit breaker in the circuit supplying the short.

The Kinetics design offers low-line regulation and the output is very nearly a perfect sine wave. A high degree of reliability is achieved by the use of extremely rugged components and the lack of complex circuitry. The Kinetics inverter is naturally well-suited to severe environmental conditions. Write or phone for more information: Kinetics Corporation, Dept. K-35, 430 South Cedron Avenue, Schaumburg, Calif. 94065 or 4-4351.



AVIONICS



MOLECTRONIC functional elements (left photo) have of nearly 20 developed by Westinghouse Electric under USAF sponsorship, include 0 to 1 a 5 watt audio amplifier, a two-channel radio receiver and a two-channel video amplifier which operates at 1 sec. Devides semiconductor crystal (right photo), which grows in the form of a thin ribbon, can be identified into a complete transistor or molelectron device while being grown or drawn into the former using new techniques developed by Westinghouse scientists.

Molelectron Developments Demonstrated

By Philip J. Klaus

Westinghouse-Torchington which made it possible to fabricate complex molelectron circuits and complete semiconductor devices while the semiconductor crystal is being grown have been developed by Westinghouse Electric Corp.

This was revealed during the first public program report on the Air Force sponsored molelectron program at which Westinghouse demonstrated nearly 10 molelectron complex circuit functions which can now be performed using two new molelectron elements.

Each consists of one or more semiconducting materials, fabricated as an integral circuit without conventional resistors, capacitors, inductors, transistors or current semiconductor connections.

Westinghouse has made "remarkable progress" in the first year results of its program, according to Col. W. S. Hanner, chief of Wright Air Development Division's Electronic Technology Laboratory.

Excited Expectations

Top Westinghouse officials and supporters who were extremely optimistic was months ago at the start of the program, growth exhibited in Avionics Week that program to date has greatly exceeded their original expectations.

Details on the Air Force/Westinghouse program were first disclosed by AVIATION WEEK (May 27, 1959 p. 54). Under the \$2 million Air Force con-

tract aimed at determining the feasibility of the molelectron concept, Westinghouse was to attempt to develop molelectron versions of eight functional circuits that are widely used in most equipment during the next quarter year. In each case, according to Westinghouse, has come up with nearly 30 different molelectron circuit functions and the pace of development is accelerating.

'It Is Here Today'

"Molelectron electronics is feasible and it is here today," Col. Hanner said. He disclosed that Air Force hopes to provide needed \$1 million for Westinghouse for continued molelectron effort during the coming year. AVIATION

Week also learned that USAF has given Texas Instruments a \$1 million contract to design and fabricate an entire airborne digital computer which will utilize the molelectron techniques throughout.

Westinghouse revealed that it has scored important advances in its novel molelectron process for growing semiconductor crystals which not only open up new molelectron possibilities but which also could have a major impact on the manufacture of conventional transistors and other semiconductor devices.

Nine months ago Westinghouse disclosed that it had developed a process for growing semiconductor crystals in the form of extremely thin, narrow sheets whose surfaces have optical fea-

Future Impact of Molelectronics

Molelectronics will have a big impact on computers that use semiconductor transistors components and they were urged to "get on board" the new technology by Col. W. S. Hanner, Wright Air Development Center Electronic Technology Laboratory. A similar warning was sounded nearly two years ago by AVIATION WEEK (June 2, 1957, p. 65). "Molelectron concepts may upset traditional lines of demarcation between electronic component and equipment manufacturers. Because molelectron circuits provide a direct route to conventional parts, it is logical to expect component manufacturers to move to protect their position. However, molelectron circuitry development will require much more research and know-how than any of the smaller component manufacturers now possess."

Similar component manufacturers also will be handicapped because molelectron circuitry tends to produce functional results rather than merely to reproduce existing combinations of conventional components by a new manufacturing process. Thus the developer of molelectron circuitry also requires considerable knowledge of electronic circuitry and its function to the equipment in which it will be used.

ness and a vacuum-like finish. This in itself eliminated the costly operations of cutting, drying, grinding and lapping, usually required to achieve a large range of semiconductor crystals produced by conventional techniques in the few days required for a transistor.

Wotrzykowski now has developed a new technique which enables it to come out the different, plating and composition steps required for transistor manufacture directly on the desirable metal, as it grows from the furnace such, Dr. S. W. Howard revealed. This would in essence, save percent in change of material.

Using this new technique, it is pos-

sible to produce a series of transistors on the long semiconductor ribbon which need only be cut off the ribbon and have few leads attached to become completed operating devices, with a yield now near 100%," Dr. Howard said.

Because these ribbons consist of a series of thin, overlapping elements, an amplifier of almost any desired gain can be produced by merely cutting off a strip with the required number of individual elements, Howard indicated.

An even more recent and significant achievement, Howard said, is the discovery of how to grow continuous crystals in detectors, directly from the

furnace itself. This makes it possible to grow crystals which have at least three terminals and two contacts, thereby solving this need for diffusion, evaporation and plating processes for many types of devices.

'Major Event'

This new development is a "major event in the new technology of molecular electronics," Howard said. The ability to grow multiterminal crystals and to perform operations on the crystal at the time it is growing in the furnace opens the way to non-automatic production of semiconductor devices and multiterminal crystal elements, he added.

"It is probable," Howard said, "that we will eventually be able to grow from a part of multiterminal semiconductor materials some class of electronic equipment that today are of the order of complexity of radio sources and amplifiers."

Wotrzykowski has fabricated a complete multiterminal element entirely by the crystal growing process, a specimen reported.

Discontinued Functions

Here are some of the multielectron functional elements, developed by Wotrzykowski, which were chosen shortly recently for representatives of the three services and the Defense Department.

- **Audio amplifier**, with output of five watts (when fitted with a heat sink) and a frequency range from audio to 10 Mc. maximum drive is in character.

- **Discontinuous amplifier**, whose full watt output is controlled by about four milliamperes current.

- **Video amplifier**, two stage, with response controls that run to a frequency of about 5 mc. maximum signal is 1 V. i. e.

- **Travel amplifier**, using a semiconductor notch filter, which has a sharp frequency selectivity and a higher figure of merit than can be obtained through use of large coils in conventional circuits.

Frequency of the band amplifier can be varied by changing applied voltage. Tuning range is far wider than the bandpass limit that capacitors use.

- **Multielectron** of three types were demonstrated: bistable, monostable and antistable. The bistable type is used in computer applications; the monostable for delaying a signal, producing a pulse in representing a code; pulse, the antistable is used for synchronization of order and reference systems.

Wotrzykowski demonstrated multielectron capable of operating at frequencies as low as 0.1 cps to as high as 3 mc. The latter, assigned a value of about one hundred thousandth of a milliwatt.

Company has fabricated a series of 12 multielectrons on a ribbon of disordered

semiconductor measuring only 1 mm long.

- **Logic switch**, which can function as an "AND" or an "OR," and can be set for input signals and five output loads.
- **Variable potentiometer**, with no moving parts, which generates a signal proportional to the product of two input signals. The circuit device accepts a spin, no longer than the soldering iron used on conventional multielectron potentiometers.

- **Optical and infrared buffer**, whose output frequency varies in a discrete function of the relative position of a source of radiation.

- **Stochastic transmitter**, using a binary random process, in which the multielectron elements itself is about the size of the end of a kitchen match. Other multielectron circuit elements demonstrated included a modulator, oscillator, contactless generator, pulse generator, notch filter, infrared buffer, an analog to digital converter using an NPNP electronic multiplier and a wall type NPNP switch with a long life time.

Next Step

During the next year, Wotrzykowski will continue to develop new multielectron ideas for performing additional circuit functions. This will include replacement of rare semiconductor materials, including the fluorine compounds.

Company also will devote more effort to the making of existing circuit functions in an effort to develop a complete equipment using only multielectron technology. One specific objective will be a very high frequency (VHF) communication receiver, as a VME transmitter.

To reduce the full inherent disadvantages of multielectrons will require that most if not all of its equipment will be made in silicon. Air Force and Westinghouse believe, however, that the use of silicon and VME will encourage atomic component manufacturers to start applying presently available multielectron functional elements wherever possible.

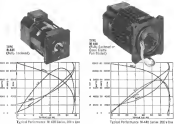
Wotrzykowski has been in basic research in research and development that it has not yet decided whether to market these multielectron elements as separate devices. However, others companies that are interested in picking up such developments and marketing them will be able to obtain license rights to any techniques which were developed with Wotrzykowski's leads. Col. Blumstein believes.

Dr. Howard predicts that in three to five years "we will see the multielectron electronic concept widely applied to all space electronic systems for such important applications as television, fire control guidance, communications, instrumentation and light control systems."

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Electronic Fuel Control Tested on T56

Dallas, Tex.—An all-transistorized solid state electronic temperature-sensing control developed here by Texas Instruments, Inc., soon is undergoing qualification on the Allison T56-A-107V turbo-prop engine, scheduled for the Lockheed P5V-1 and Grumman A2F-1 patrol and attack aircraft.

A prime feature of the equipment is that it permits the turbo-prop power plant to be operated closely to the engine's optimal limit for optimum efficiency in power and fuel economy. As a sign of its effectiveness its installation on the Allison T56-D13 engine permits turbine inlet temperatures to run only between 957°C and 977°C at full takeoff power, compared with a spread of 904°C to 1099°C that could be experienced without such control, according to Eugene Reed, section chief, electronic systems, instruments and accessories department of Texas Instruments' Aerospace Division.

Reliability of the unit, proven in one crucial operation on the T56-D13 turbo-prop installed in the Lockheed Electra is indicated by the fact that it attained some 175,000 hr usage in 11 aircraft without a single airborne failure and has gone some 147,000 flying hours in service with only two substantiated airborne failures, he told Associate Editors.

Partake further of the equipment provides for control to continue to be handled by the thermomechanical governor of the engine directly under the pilot's supervision with the pilot firing its influence to the turbine inlet temperature reduction on his panel.

Other Applications

Success with these entry into the electronic fuel control field has led company engineers to consider other applications of such equipment to the broad spectrum of jet, piston and turbine power units. For optimum results and economy using the economies of new equipment capabilities, reductions are that Lockheed's program is modified. Best possible lies in starting with a new engine that has not yet reached production stage.

Usefulness it appears that Texas Instruments is working closely with General Electric in an electronic fuel control installation on the industrial version of the T56-A-107 turbo-prop. Industries are that it can also be applied without the Rockwell's 15,000-hr 15-thrust single engine motor, which would install providing a rapid responding fuel and oxidizer ratio to provide proper air-fuel ratio that would give thrust demanded by a powerplant—rather than a fixed, compared with a fixed demand and fuel ratio varied according).



ELECTRONIC fuel control package for Allison T56-D13 turbo-prop engine designed in a modified form for rapid removal and replacement of components

Limited production of such power plant systems, evaluation has caused some producers to carefully consider maintaining the work volume, but Texas Instruments apparently holds that there is a market where production quantities are achieved. The company also feels that the turbine propeller field offers a good market, particularly since turbine installations are throughout varied in electronic control applications.

Basically the Texas Instruments Model 40168-1 electronic fuel control provides two operational modes, turbine inlet temperature limiting and controlling, which can be switching in the engine inlet of the pilot's view. There are two temperature limiting levels in the limit mode: 957°C and 977°C. The bottom end of the temperature scale is experienced during engine start and low speed time. The change from low speed to high speed to normal limiting at 977°C occurs at 15,000 rpm, with the power limit angle at 10 deg. From 10 deg. to 64 deg. power limit settings.

At 64 deg. setting of the pilot's power level, a transition occurs from the limiting mode to the controlling mode. Throughout this latter mode, the pilot selects desired power by means of the lever, with mechanical linkage transmitting his command to the same fuel control. The main fuel control passes to the fuel actuator valve that equal to 125% of the engine requirement.

Normally, the fuel metering valve meters 100% of the fuel requirement and beyond the signal shock has been received from the main fuel control. The mechanical linkage, which passes pilot's power demands to the main fuel

control turbine inlet temperature limiting occurs.

All through the limit modes, the electronic temperature reference fuel control unit continuously fuel scheduling to the thermomechanical portion of the engine, but retains an ability to keep engine temperatures within safety limits.

Mode Transition

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controls, power through an electronic channel recorder. This channel recorder level setting channel with known controls and sends a desired temperature signal to the electronic fuel control unit.

In the air, desired temperature signal is compared with the actual fuel inlet temperature signal, received from thermocouples at the inlet. After comparison, a correction signal is sent to the actuating valve, maintaining or decreasing fuel flow through the fuel actuating valve to the engine to re-establish temperature balance.

Detailed view of the operation is shown as the electronic control opens its comparison with the comparison potentiometer, engine fuel flow, a set of 18 channel-based thermocouples and the temperature datum valve maintaining selected turbine inlet temperature in the flight range of engine operation and during automatic temperature throughout the operating range.

Bypass Device

The temperature datum valve, operated by the electronic temperature datum control, is installed at a bypassing device in the engine fuel system, with the datum valve located between the main fuel control and the engine fuel manifold. The datum valve has a null position, at which point a fixed percentage of main fuel control signal is bypassed back to the engine fuel pump. The datum valve is at null when the engine is operating "on temperature," and no signal is supplied from the electronic control to a two-phase motor in the datum valve.

Electronic control response to a turbine inlet on-temperature control datum valve to bypass a greater amount of fuel to reduce turbine inlet temperature to a predetermined value. This reduction, in effect of on-temperature, occurs when the electronic control is aligned for either the heating or controlling operation.

For controlling operation, electronic control response to a turbine inlet on-temperature control datum valve to bypass less fuel, increasing engine fuel flow and turbine inlet temperature. In the heating mode, electronic control response to an on-temperature will not provide a signal large enough to cause the datum valve motor to make a temperature/fuel flow correction, although engine fuel flow and turbine inlet temperature will be increased slightly if the fuel flow through the datum valve has previously been corrected to relieve on-temperature.

A small signal from the electronic control will adjust datum valve action to its null position, against ground pressure, from the control, from the turbine, resulting in a corresponding slight in-

crease in fuel flow and temperature.

During engine start and operation up to achieving rated engine temperature, following engine within the electronic control is operative. If turbine inlet temperature exceeds a preselected value, electronic control action causes the temperature datum valve to reduce engine fuel flow to relieve on-temperature.

In the 15-900 deg. normal flight range power level limit, temperature controlling circuit is operative, electronic control action causes the temperature datum valve to increase fuel flow to maintain turbine inlet temperature scheduled by the power lever for an increase in decrease of fuel flow.

During landing, a manual switch returns the electronic control to limiting action from the normal flight temperature controlling action. A 74% credit to the selected engine brake on the datum valve motor shift a re-configured to engage the brake. The brake then feeds the datum valve in its operating position at the lower fuel levels was desired. If engine on-temperature develops, electronic control causes the selected brake to release and the main on-temperature signal that caused this action causes the datum valve to reduce fuel flow to reduce temperature.

Limit Functions

The electronic temperature datum control consists of a thermocouple multi-voltage converter and modulation unit, an on-temperature signal, a de-modulation and output amplifier and a power supply. Other circuits in the control perform monitoring the on-temperature for either heating or controlling functions and permit release of the selected brake in the datum valve motor. The selected brake release action occurs only when engine on-temperature has been previously selected for heating operation and an on-temperature occurs.

In the comparison circuit, thermocouple generated voltage is compared with a reference millivoltage, the millivoltage difference or error between the two is modulated and converted to a signal. The modulated signal is de-modulated, phase demodulated and applied to control windings of a solenoid motor, which in turn controls variable phase output from the control to the datum valve motor. Electronic control circuitry is installed for either heating or controlling operation by the in-flight selector relay in the control.

Control output at both field and variable phase 400-cycles voltage supplied to a two-phase induction motor in the associated datum valve. Motor response to the variable phase voltage regulated by presence of the datum valve to regulate engine fuel supply and turbine inlet temperature. Magnitude and

phase of the variable phase output voltage, is set by the amount and direction of fuel turbine inlet temperature varies from the reference temperature.

During both heating and controlling operation, a generator located on the time shift at the datum valve motor produces an ac voltage proportional to motor rotation speed. Phase of the voltage is referenced to generator excitation, is determined by the direction of motor rotation. This ac voltage is fed back to the electronic control to keep the motor speed and reduce its supply rate to a turbine inlet temperature correction is being made. This feedback action allows high motor starting torque to meet engine needs and provide stability.

Packaged Circuits

Components in the system are derived 90% of the suppliers' designs to build reliability under rated conditions. Components packaged in modules form to provide easy maintenance. This unit is designed to just exchange modules including an operational temperature range of -75F to +125F, ambient pressure at 101,000 ft. altitude, operation at 1 to 276 cps and 100 rpm per cycle rate of wind and dust loading at 100 fpm, operation after exposure for 15 days in clean water vapor atmosphere at 95% humidity and temperature of 70F through 140F.

Also tested in operation at sustained acceleration of 10g along each of its three perpendicular axes and after 24 impact shocks of 30g each through its three axes and during vibration in frequency range of 1 to 276 cps and at amplitudes of 0.1 in or 1g.

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• **Optique Compound Photoconductor**—Optique films of photoconductive, a class of organic chemical compounds, formed as an alloy, with other elements increases the dark conductivity of the film by as much as 10 million times and the threshold photoconductivity to 100 fms/cm. Work not published at the University of California under contract from the Air Force Office, Cambridge.

• **Solar Battery Damage-Reduction** is water space appears to damage and degrade operation of solar battery sources, according to Dr. James Van Allen. He attributes unexpected early failure of space-based photovoltaic satellites to such damage.

• **Optical Mouse-Rise** for successful operation of fast optical Mouse new systems according to three groups: Columbia University team under Dr.

Charles H. Townes, Bell Telephone Laboratories; Drs. Al. Inan and W. B. Bennett, Jr. and a 15-man team at Teknical Research Group, Inc. Next four months should be decisive.

• **Temple Island Amplifier**—First model of a gas amplifier based on new technique involving a solid-state vacuum tube in its design, is in early stages of development at Teknical Research Group, Inc. under a near-\$100,000 contract from Rensselaer Air Development Center. Initial operation aimed at V-band millimeter range, first intended design to detect lower frequency called in Island Amplifier is expected to have low noise capabilities of Maser and parametric amplifier, but designed to detect higher frequencies than the latter, at room temperatures and without magnets, according to RADC notes.

• **High Resolution, Small Antenna Radar**—Developed by Project Nikebag, airborne radar under small antennas, because the larger one by using several forward antennas, sampling, timing and combining returns for resolution. Target range, 30 miles, is achieved by use of independent of range. This Project Nikebag was sponsored by Army Combat Surveillance Agency.

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SMALLEST LIGHTEST CARCINOTRONS

with wide band sole tuning



Though it has just recently made its debut into the high society of Lithon microwave tubes, this carcinotron (our model L-3285) has already been commended by the military for its exceptionally sleek design. Every engineer concerned with upgrading the performance of ECM equipment will surely find much of interest in this medium-power tube, with which Lithon takes a major stride toward truly simultaneous noise-jamming capability by affording faster tuning rates than any previously attainable.

The Lithon family of eight extremely compatible carcinotrons is the first to incorporate the virtual capability of wide band sole tuning without frequency or power holes when the tube is operated into as much as a 1.5-to-1 mismatch. Lithon carcinotrons are the first to use wide-band-on-board RF output couplers, eliminating many system compatibility headaches as well as sideband, waveguide plumbing, and lead troubles.

We cite these firsts not for glory's sake, but rather for their meaningful contribution to more efficient system designs, smaller size and lighter weight.

The versatile versatility of these carcinotrons is not limited to ECM. You can also consider them for other military applications such as drivers for communications links—on fact, wherever medium-power tubes with extremely rapid tuning and low tuning power are required. Because of their mechanical and electrical compatibility the eight tubes in the family are interchangeable, so there's



These versatile tubes are not just drawing-board products—you can order them now.

Write concerning voltage-tuned power oscillators of whatever nature to Lithon Industries, Electron Tube Division, Office AS, 960 Industrial Road, San Carlos, California. Your request for our Carcinotron Catalog or for answers to your specific questions will be honored promptly.



LITHON INDUSTRIES Electron Tube Division
BROADBAND TRANSMITTERS • TUBES • CARCINOTRONS • LASERS • THERMAL NOISE TUBES • AUTOMATICALLY
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CAPABILITY THAT CAN CHANGE YOUR PLANNING



cap swings out of way for service or adjustment. Customer is available in five sizes with port height ranging from 18 in. to 24 in. The Butler Corp., 4571 Valley Blvd., Los Angeles 32, Calif.

• **Silicon controlled rectifier.** Types T1110 through T1-114, are rated at 1 amp from 33 to 400 v. and are packaged in JEDEC TO-18 case. The power dissipated silicon rectifiers provide 1 amp outputs at 500 vdc peak-to-peak and average rectified forward currents



of 300 ma at 125°C case temperature with 50 and 100 forward bias-current ratings from 10 to 100 v. Maximum average forward current is 20 ma with rise, holding current of 25 ma and zero leakage at 50 v. Texas Instruments, Inc., P.O. Box 311, Dallas, Tex.

• **Low-level multistage, SE, series** can amplify up to 58 low-level differential data inputs and are available in single speed or multiple speed models capable of processing all standard TRIC signals. Separate outputs are provided for visual and PANI signal with master pulse, standard PDMA, and differential PDMA output. Accuracy is said to be 1% or greater of 20 ms. amplitude full scale. Units measure 4 in. x 4 in. x 7 in., weigh 6 lb., draw less than 5 w.

from 25-w dc source, and use silicon devices throughout. General Devices, Inc., Box 251, Waverly, N. J.

• **Precision potentiometers, TF series**, are single-turn, rotary, wirewound types designed for durable and reliable operation under severe environments, with built-in torque device to hold the shaft in position under shock or vibration. Shells are available in 6 or 12 in. diam. TF series range in size from 4 in. submount to 12 in. diameter. Technology Instrument Corp., Note 31, Acton, Mass.

• **Thermistor, Type GS48**, hermetically sealed in glass probe, offers 100,000 ohm resistance plus or minus 10% at liquid nitrogen temperatures (approx-



imately -70°C). Time constant of device is less than 1 sec. and temperature coefficient is minus 20%/degree K both referred to liquid nitrogen temperatures.

Instruments

• **Secondary time standard, WWV 1**, is portable, battery-powered time standard accurate to 16 sec. a year and used to control information transmission and recording instruments. Device is time-stabilized, contains 7 x 11 x 7 in. in handle-mount case, weighs 8 lb. complete with two batteries which will operate for several months before and for replacement according to firm, Zetech Radio Corp., 6001 W. Dickens Ave., Chaco, N. M.

• **Paper-to-magnetic tape converter, Model D104**, can convert punched paper tape produced in teletype transmission to magnetic tape or magnetic paper tape data is introduced into the



D104 by a photostatic reader operating at 180 characters per second and magnetic tape can be read or prepared in form compatible with computers at it is fed, according to the firm. Converter will interface from translation into tape typing error, extraneous noise, and spurious messages. Digitalis Corp., Albion, N. Y.

• **Dialscope, Type 435**, features direct digital reading system and can be used over frequency range from 0.5 to 60 mc (down 1 db at 50 mc). Model



consists of five basic modules built into main case for measurement and inputs, and has interchangeable amplifiers for sensitivity and impedance input characteristics.

Accuracy of measured readings of base and amplitude is 2%, according to the firm, Allen B. DuMont Laboratories, Inc., Chino, N. J.



• **Telemetry amplifier, Model PA-11**, designed to boost a 2-w. signal up to 100 w., operates in 225 to 700 mc band over a 40-mhz-wide range. Input varies 0.7V to 170V. Power amplifier can withstand vibration of 30g from 20 to 2,000 cps, shock and acceleration of 100g each. An internally contained 400-psi blow-out relief for maximum RF output. United Electronic Dynamics, Inc., 100 Alameda Rd., Pasadena, Calif.



ACs RIGHT FOR RICK

ACs Spark *Right* Helicopters from Arctic to Tropics . . .



James R. Beggs, President of Rick Helicopters, Inc., talks about the superior performance of AC Aircraft Spark Plugs with his maintenance men.

From checking highway construction to air-lifting telephone poles into the mountains . . . from crop spraying to forest fire fighting . . . reliability characterizes the service of Rick Helicopters, Inc. Based in San Francisco, Rick is one of the largest and most experienced helicopter operators in the country.

Here's why AC Motors, Rick's maintenance manager, insists that reliable AC Aircraft Spark Plugs are right for Rick: "AC plugs require a minimum of maintenance and replacement; the self-cleaning characteristics of ACs eliminate delays caused by spark plug fouling."

This is especially true of AC Spark Plugs with platinum electrodes. The excellent long life quality of platinum and the small diameter center electrode permit a long, fine insulator tip design. This design improves oil and lead anti-fouling characteristics.

AC SPARK PLUGS ARE THE ELECTRONIC DIVISION OF GENERAL MOTORS



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BUSINESS FLYING



SINGLE-ENGINE service ceiling of the Piper Arrow, with full fuel and five passengers plus baggage, is specified as 7,400 ft.

Aviation Week Pilot Report:

Piper's New Twin Shows Flight Advances

By Robert I. Stadfeld

New Twin-Injected design features plus the power of Piper's new Superstar PA-35-140 Arrow are reflected in performance of the executive light-twin which combines a goal rate of climb with 200 mph plus cruise speeds. It has smooth stall characteristics and is economical and stable during both slow flight and enroute procedures.

The Arrow is basically a derivative of the twin Apache. Physical occupation is a nice improvement, including a single radio and single-pedal stabilizer tender to that of the Conquest, and two rear windows which have been added ahead of the rear fifth seat. The Arrow also shares various (such as electrical and hydraulic) and components of the Apache.

Rated Power

Power is furnished by two Lycoming O-540-A1B5 rev-limited engines, each rated at 230 hp at 2,575 rpm. Compression ratio is 9.5:1. Fuel grade is 91/96 octane. Propellers are two-bladed Hartzell HC-87NK-2C1 constant-speed units.

Significant and performance talks for the Arrow was listed in the No. 2 issue of *Aviation Week* (pp. 112-113). The standard model has no empty weight of 2,775 lb. Useful load is 2,011 lb. and maximum gross weight 4,786 lb. Span is 37 ft., length 27-ft. 6 in. and height 10 ft. 3 in. Baggage capacity is 200

lb., fuel capacity 144 gal. Fuel consumption, 55% power is 24 gal. hr.

Cruise speed of the Arrow is 211 mph, and specified rate of climb is 1,650 fpm. Service ceiling is 22,500 ft. Single-engine ceiling, which Piper says is the highest for any light twin of the Arrow class, with full fuel, five pas-

senger, baggage and equipment is 7,400 ft. At a gross weight of 4,400 lb., the single-engine ceiling is 10,500 ft.

Take-off speed, full fuel, the Arrow with five passengers has more than 150 lb. baggage allowance. Cruise range, 750° power is 1,825 stat. mi. (5.5 hrs.) economy cruise range, 615° power is



ADJUSTABLE seats are in reclined to three positions. The seat instrument panel sets light instruments left, engine instruments right. Radio controls are optional.

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Extremely compact... Meet the most exacting requirements of the military and aerospace industry... Perfect for aircraft receptacle systems, communications, and electronic instruments... Positive make and break—toggle works directly as movable contact member... Wiping action insures good dry contact... Positive detent for better operation... Spindled body has high breaking resistance, good recovery voltage... Available in 2 and 3 positions, single and double pole construction, unactuated or momentary action. Wide in Digi, CDR.

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Cutler-Hammer Inc., Milwaukee, Wis. • Bruce Anderson Instruments Laboratory, • Victory Cutler-Hammer International, C.A.
Aircraft Cutler-Hammer Ltd., Ltd., Cutler-Hammer (UK) Ltd., S.A. International Electronics Corporation.

FUEL VALVES, cross-hatched pistons and
lower models are between the front seats



BATTERY, 12s, 30-amp D-c, is mounted
on the right side of the same section

10,000 ft., a 1,400-hp (1.5 hr.)
... After performance characteristics
enclosed during Aviation Week
light evaluation included:
• Rate of climb: Weighing about 1,400 lb., the aircraft climbed to 10,000 ft. in 1:40 sec. Holding this speed constant, the engine climbed through 5,000 ft. at 1,600 rpm, 5,000 ft. at 1,400 rpm and 9,000 ft. at 1,100 rpm.
• Cruise speeds: At 7,000 ft., outside air temperature of -5C, and pulling 750 power, 22.25 in. manifold pressure and 1,400 rpm, the Astor indicated 290 mph. At a true airspeed of 200 mph at 10,000 ft., temperature -11C, power to 65% and 20 in. and 2,400 rpm, the light time indicated 180 mph for a true reading of 207 mph.
• Fuel and speed: At 7,500 ft. power, 22.25 in. manifold pressure and 1,400 rpm, the Astor indicated 290 mph. At a true airspeed of 200 mph at 10,000 ft., temperature -11C, power to 65% and 20 in. and 2,400 rpm, the light time indicated 180 mph for a true reading of 207 mph.
• Fuel and speed: At 7,500 ft. power, 22.25 in. manifold pressure and 1,400 rpm, the Astor indicated 290 mph. At a true airspeed of 200 mph at 10,000 ft., temperature -11C, power to 65% and 20 in. and 2,400 rpm, the light time indicated 180 mph for a true reading of 207 mph.

• **Single-engine**: With the right propeller selected at 7,000 ft. and the left engine pulling 75% power, the engine indicated 145 mph. Climb rate from this altitude, holding an indicated 185 mph, was 400 fpm. During sustained single-engine climb, power in the right engine reduced to 70 in., the engine, once cleared up, climbed at 1,200 fpm at 100 rpm. Maximum convertible single-engine speed is 80 mph.

Selected by Navy

The Navy has selected the equivalent of the Astor Astor (with a special radio package) designated the UC-13 as its "off-the-shelf" utility/advisor.

two seats (resulting in excellent in competition with other light aircraft (AV 100, p. 18). Initial Navy contract for 20 airplanes, which will be ordered within the continental limits of the U.S., near about 50 million. Paper has proposed that the UC-13 be used, and engine mounted, in its distribution-delivery operation.

Cost of the standard Astor, less radio navigation equipment, is \$49,500. The major custom model, priced at \$55,555, includes: Navy Commander M2, 2 man crew, VOR communication and VOR, ILS inductor selector, Nemo Mark 5 transmitter/receiver, Nemo CS-3A VOR/ILS inductor selector, and

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Run is the most critical time in the life of an engine. Run-in burnishes the parts, guarantees, to an amazing degree, the successful life of the engine. More care in the run-in will mean more long term protection for your pocketbook.

Here's how typical Aircraft Test Cell Engines that make your engine is ready for maximum service.

Oil pressure and temperature are used in many different parts of the engine — helping in prompt trouble diagnosis before they occur. The volume of oil moving through the engine is measured, too.

Airflow systems are checked with a scientific precision analyzer. This makes sure engine component is operating properly.

Oil consumption and fuel consumption are checked by automatic systems. We don't depend on dip stick tests.


At seven days of fuel flowing, every engine is used before leaving. Parts tested during the run, a lower down for design variation on a five years for design variation.

We should add a fifth. Airwork runs 100 — adherence to standards above normal factory requirements. Airwork overhead support are essential because you are in operating mode. Can we send you pictures?


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TURBINE PROPULSION



30100 FRL-PROPPELLER



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Continental Aviation & Engineering Corp. is exceptionally well qualified, both by experience and by facilities, for work on the weapons systems of tomorrow. Our background embraces not only a half-century of internal combustion engine experience, but also years of pioneering in gas turbine engine development, and more than a decade in the field of solid fuels for vertical propulsion of missiles and target drones.

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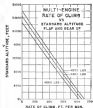
The CAE record of achievement is one of which every larger company might be proud. Inquiries are invited from those having propulsion problems, at the ground, or the water, or the air.



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SUBSIDIARY OF CONTINENTAL MOTOR CORPORATION



Rate of climb of standard gas weight, 4500 lb., is about 1630 fpm.

speed at 120 mph (best rate of climb) occurred at 3,000 fpm.

Climb was continued to 7,000 ft., at climb power of 24 in. manifold pressure and 2,400 rpm, full power reduction. Rate of climb at 7,000 ft. was about 3,000 fpm. Fuel flow was good during the climb and throughout the flight. Rate of climb, at stated rates, was from 1,600 fpm. at 1,500 ft. to 1,100 fpm. going through 5,000 ft. The airplane responded smoothly and flexibly to control pressures, turned out, it did a good job of diving by itself.

Active engines can be cranked at any pressure of power from 75% down. Coordinated climb runs down to 1,500 rpm, 2,400 rpm, is recommended for zero-zero climb performance. Propellers forced 2,400 rpm at both 7,000 ft. and 10,000 ft. to obtain the indicated speeds of 100 mph and 150 mph previously stated. This was then, produced a true reading of 706 and 700 mph. Climb from 7,000 ft. to 10,000 ft., at 20.5 in. and 2,400 rpm, holding 100 mph, averaged 1,190 fpm.

Quick Feathering

Prop feathering is accomplished by moving the pitch lever fully aft through the high pitch detent into the feathering position. The right propeller was feathered at 7,000 ft., feather time about 3 sec. The procedure was quick and feathered was easy to manage. Slight rudder pressure and a minimum of aileron pressure held directional control. Left turn would be necessary. Normal angle engine constant speed at low altitudes is 115 mph. With the left engine pulling 22 in. and 2,400 rpm (75% power) the Aircor indicated 145 mph.

Without trimming, the airplane was pulled up gently until speed indicated 100 mph. Rate of climb was 400 fpm. Before feathering, tendency to drop

turns were made both left and right, no distinct tendency was evident. A full-down stall, both in climb and landing configuration, resulted in double "bumps" at 60 mph and 65 mph, respectively. Airplane popped from one to the other. The Aircor is equipped with a Safe Flight stall warning indicator that is actuated about 10 mph preceding stall.

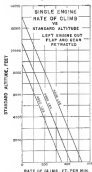
During this flight, at temperatures to -11C, the Aircor was comfortable and none level was not excessive. Only discomfort was wind, which did a fine job. Normal cross-country was possible throughout this evaluation.

Caution Range

Aircor approach is indicated at 240 mph. The caution range begins at 190 mph. A safety factor of about 5 mph is added to the 80 mph maximum angle-of-attack control speed. The gear can be extended at speeds under 150 mph, flaps under 125 mph. Normal approach speed is about 50-55 mph. A good approach angle can be set up with about 12 in. manifold pressure and 2,400 rpm.

Descent from 10,000 ft. was made with power reduction to 13 in. manifold pressure, which produced a good angle and a 500 fpm. rate of descent. Aircor trim tabs in response, and a small control adjustment gives a rapid attitude change.

Several landings were made at Mac



Aircor single-engine climb is 10,700 ft. at 4,000 ft.





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- ★ **Flush Fracture (No Stem Trimming)**
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Townsend Company

WILMINGTON, DEL. & NEW BRUNSWICK, N.J.

Elements by Hans-Martinus Kasper, Oliver Dornst and Stefan

Item	1959 November	Total Jan.-Nov. 1959
Complete aircraft, total aircraft weight (under 500 lb.)	3,440 F	38,218
By weight of planes:		
Under 3,000 lb. aircraft weight	426 A	7,379
3,000 lb. aircraft weight and over	1,368 B	18,349
By number of planes:		
1- and 2-places	426	4,627
3- and 4-places	426	4,627
Over 5-places	1,046 C	11,099
By total rated horsepower, all engines:		
Under 100 hp	426	4,627
100-300 hp	426	4,627
Over 300 hp and over	3,440 D	34,224
Aircraft engines		
Reciprocating	November	1,140
Gas turbine	(2)	(2)
Aircraft engines, total horsepower:		
Reciprocating (solid 400 hp)	882 E	5,322
Gas turbine	(2) (3)	(3)
Complete aircraft	November	762
By weight of planes:		
Under 3,000 lb. aircraft weight	426	7,379
3,000 lb. aircraft weight and over	42	405
By number of planes:		
1- and 2-places	426	4,627
3- and 4-places	426	4,627
Over 5-places	44	504
By total rated horsepower, all engines:		
Under 100 hp	426	4,627
100-300 hp	426	4,627
Over 300 hp and over	34	328
Value of elements of complete aircraft and parts, total	(5,440)	86,428
Aircraft, total		79,492
Under 3,000 lb. aircraft weight	426	116,461
3,000 lb. aircraft weight and over	426	479,011
Aircraft parts		4,476
Value of elements of aircraft engines and parts, total		34,328
Aircraft engines		
Reciprocating	4,476	(1)
Gas turbine	(2)	(2)
Engine parts	10,710	128,472
Shuffled engines (under 3,000 lb. aircraft weight and over)	November	426

^a = Withheld to avoid disclosing figures for individual companies. Data prepared by Bureau of the Census, Industry Division, Machinery & Equipment, received from 33 companies operating 22 plants producing complete aircraft and engine engine companies including seven plants.

Arthur Field, Jilip, using an average 95 mph approach speed. In event of a hydraulic pump failure, on left engine (driving the pump) failure, gear or flaps would have been extended on the annual hydraulic pump located on the center quadrant. A gear-up emergency landing can be made without extensive structural damage, none of three which protrude about one-third of their diameter when retracted.

With full flaps extended, approach rate of descent was 400 fpm. The airplane was brought over the fence at 50 mph and touched down at 70 mph. Low speed lateral control and directional stability are pronounced in this airplane. The Astor rolled no more than 600 ft., with a sequence of braking action, into the 25 kt. wind.

The Aker has been flown off the nose easily with one propeller feathered. To simulate this condition, full power was applied on takeoff and once the Aker was rolling unassisted passenger on the right engine was reduced to 10.5 in. The airplane was held down until 100 mph was indicated, then flew straight off. With gear retracted, speed increased to 120 mph, initial climb was 1,000 fpm which increased to 1,200 fpm. Feathering is not possible if an engine falters, but single-engine flight can be maintained with the dead engine propeller feathered.

Print Leadline

Free to find landing at Flushing Airport, the *Amee* was owned at 2,500

At that low altitude, with power to 22 in manifold pressure and 2,500 rpm, the airplane indicated 180 mph. The light-twin is trim and docile, it never fuss with a maximum of power and doesn't stall easily.

Isolated in the standard model Arctic wet dual vacuum pumps, a fifth seal, a mixing beacon, a heated pint tube, and complete instrumentation for instrument flight rule operations.

Both engines in all Astron are equipped with a gear-driven, gear-driven, vacuum pump, first-type carburetor, two magneto, dual-lift valves and spark plugs, displacement fuel pump, propeller governor and oil thermostat. The left engine only is equipped with a hydraulic pump.

The lead-in system is used both for extension and retraction of the gear and flap, operated from the control pedestal. Gear retraction-extension usually occurs within 10-12 sec; flap operations require about 4 sec. In addition to the hand pump, a GEP pneumatic system provides a dual gear extension method.

The 12-v, 13-amp/hr battery is mounted in the rear section on the left side. Wire, tie surfaces and con-



Shinn Engineering to Build Morrissey 2150

Two-plate Morley 2190 ultra-sewer will be manufactured by Moss Engineering, Inc. Santa Ana, Calif. Under the agreement William Morley, the sewer's designer, will direct sales, engineering and product development. The 2190, powered by a 150-hp engine, has a top speed of 240 mph, loads at 32 mph and clocks at 1,480 ft/min. Cylinders of the aluminum sewer are listed at 21,900 lb. Purchase prices from Santa Ana is \$5,100.

poller driving systems are available as optional equipment.

In January the Actors were selling off the Piper production line at Lock Haven, Pa., at the rate of one a day. In February, the rate increased to two a

July. To accelerate Apache deliveries to dealers, Piper has stopped Apache production elsewhere as early as March.

For the completely equipped Arctic which Piper estimates would cost \$59,000, launch-diecast costs are specified as \$18.19. This includes \$41.40 for gas and oil, \$7.93 for inspection and maintenance, and \$3.78 as reserve for engine and propeller overhaul. Annual student costs are estimated at \$2,000.

That includes trigger cost (\$40 a month), of \$460, insurance \$1,320, and single limit liability of \$250,000 (five years) for \$240.

On the basis of hours flown, total hourly operating costs are estimated as follows: 300 hr—\$24.99, 500 hr—\$22.27; 800 hr—\$20.29. Operating

cost per acre, at 180 depth (black to black), for these hours shows an oil costed at, respectively, 12.5 cents, 11.1 cents and 10.4 cents. For limestone gas,

poor, depreciation per acre (16% per year - 10% residual) after five years) for the same three length periods is specified as 14.7 cents, 8.8 cents and 5.5

costs. Adding operating costs per mile and depreciation per mile gives a total cost per mile, for 500, 550 and 600 lbs. of 27.2 cents, 19.9 cents and 15.9 cents. For business purposes, depreciation

of a completely equipped \$15,000 airplane, 16% per year with a 30% residual at the end of five years, would be \$5,500.

PRIVATE LINES

Hooker Chemical Co., Niagara Falls, N.Y., has purchased a new Dutch Super G88 twin for use in transporting personnel between two Hooker plants east of the Mississippi River. Chief pilot is J. P. Nock. The plane is fitted with JATO bottles (AW Feb. 1, p. 88) and a remote-control landing gear.

Western Sport Paradise Center has opened at Rona Airport, Los Angeles, Calif., as a resort hotel for professionals.

Federal Aviation Agency reports 1977 registration of civil aircraft reached 98,383, a 6% increase over 1976.

Extension of major inspection period for the Bell 47J Ranger helicopter to 1,100 hr. double the previous period is being granted to commercial operators, effective today. Major overhaul period for the Ranger's Lycoming VP-435 engine increases at 750 hr., extendable to 900 hr. after inspection.

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2000, University of Chicago Press.



WASH COUNTY CORPORATION

AD LM CA D

Los Angeles 45, California

Bell Helicopter Builds Air Cushion Craft

By Ernie J. Hoffman

Hunt, Tex.—Two variants of an offshore vehicle are demonstrated here recently by Bell Helicopter Corp., with light demonstrations of a new one, 160-hp test vehicle of the pleasure chamber configuration.

Although a relative beginner in the field, indications are that Bell's research program is geared toward developing a self-maintaining, responsive cabinless. Behind the little "air scooter" being flown is a considerable amount of ready research into varied configurations, including not only the straight pleasure chamber type but also the more sophisticated scooter and a combination of the two.

A series of model tests of two air-scooter configurations in which flow chamber attached to the rear with, with and without a control nacelle, has shown particularly efficient performance, according to Bell. The latter, powered model, weighing approximately 6 lb. and developing some 3 hp. power, has lifted 6 ft. from the floor.

The company plans to build several more, or "scoters," which will permit accelerated build up of data and provide ability to incorporate modifications at a rapid pace with a minimum slow-down in existing data.

Bell, which then has entered the air cushion program with its own funds, probably will receive more Office of

Naval Research funding shortly, according to company officials, and the company expects to continue to put in more money into the project.

An scooter demonstrated is 50 in. high, 55 in. wide, 85 in. long and is powered by a modified 16-hp. Zundapp two-cylinder motorcycle engine having a two-blade wood fan of 50 in. diameter. Pleasure chamber develops approximately 13 hp. power, which lifts the test vehicle approximately 24 ft. in the open. Short for clearing the air cushion is a fair handle-back type.

Indications are that further tests, using a larger test, will be made by putting on longer bristles and will permit a slightly more operational length. The procedure, probably will entail installing bristles of set undisturbed length and then cutting them back until sufficient stiffness is retained, despite the outward air blast.

Aluminum Scooter

The test scooter, fabricated of aluminum and covered with glass fiber, has pulled up a 120-lb. pilot and a 175-lb. passenger and attained approximately one-half inch lift off the ground.

Pleasure chamber configuration was chosen for the initial large-scale test vehicle because of its comparatively simple control and stability characteristics. Bell air scooter exhibits a simple fan starter operation, throttle a wheel-mounted right hand grip of the motor-

cycle-type handlebar. Forward acceleration is accomplished by depressing a foot pedal on the right side, which opens leaves in the rear of the vehicle.

Directional control is attained by a combination of turning the handlebars in the desired direction, which directs thrust either out of four diagonally located ports, plus application of "body angles" in the same direction. A brief first-hand trial of the air scooter by American Wires, following approximately one minute of prior instruction, indicated that the vehicle has considerable maneuverability and can be easily directed over chosen course, such as ramp markings, with considerable ease.

Stability is good. A series of runs in the fan direction is configured to turn the fan so as to create net imbalance and torque. Proper trimming of acceleration runs probably will improve forward thrust, which would permit climbing 150 ft. per second. Currently, the maximum forward speed is on the order of 25 mph.

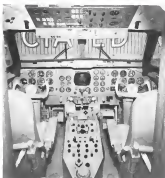
The project was initiated as a private contract, all-plant study by two 27-year-old test facilities in Bell's engineering department, Ken and Fred Wornat, who initiated the study a year ago. Starting out with electric-powered model studies, they progressed to a small outboard motor, electrically-powered, which was "test flown" by Ken Wornat's four-year-old daughter.

Bell became interested in the experiment last June and, following design sketches at the plant authorized the facilities to proceed on the current test vehicle, which was designed, built and first flown in 18 working days.

Prior considerations in the development program are basic military applications. Although still a test vehicle, the current model probably could be developed only for custom applications, including a version that would be a basic air amusement park or private transportation at lakes. Although Bell declined to estimate cost of such a configuration, indications are that a configuration similar to the present custom test vehicle might cost somewhere in the neighborhood of \$150,000 to produce in lots of approximately 25.

Because of low operating height, overwater flying probably would avoidable installation of some form of landing device to prevent the base from dipping in. Indications are that the custom will encompass overwater trials.

Obtainable clearance is another factor. Bell says the changes involved with cooperation will get quite a personal—possibly will be suitable to transport and visitors for plant inspections.



Flights incorporating control in stepped air cushion hull (left) by Horton & Horton mechanics. Note positioning of nacelle and component controls on pedestal off of engine controls in cockpit controlled by Associated Radio Corp.

Texas Firms Customize Newspaper's Gulfstream

Customizing and modification of a G-115 Gulfstream helicopter executive transport produced by the Minneapolis Office (San & Tribune) has been completed at Dallas, Tex., by Southwest Aerospace Corp. and Horton & Horton, among others.

Initial plan was to install a large nacelle mounted on the rear fuselage and then cover it with heat shield. In the meantime, however, Southwest completed modifications including a new floor to take an extra set of seat tracks and supporting structure. Completed interior, which cost under \$50,000, features a double row of five forward seats on the left side designed by Horton & Horton to boost up the cabin effect of a conventional single row cabin layout. Cargo net can be slung opposite the coach for forward view (right). Cargo unit, put above right, was tied out to pilot's requirements. Notes on a modification of sub-chamber sections and other air-scooter controls on a pedestal off of the engine controls, with conventional features, control heads replaced by special, slightly larger heads designed by Associated Radio Corp., which completed the cockpit layout. Communications equipment is installed in a rack under \$120,000. Future pilot will be involved in a 100-hour ground school for long overwater flights.



Installation of seating units on left side of Gulfstream fuselage required installation of extra tracks for rack seats. Cushion lift of coach provides forward view privacy.



BELL HELICOPTER's pleasure chamber in motor is 55 in. long. Photograph is a modified 16-hp. Zundapp two-cylinder motorcycle engine having a two-blade wood fan.

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Army Contracts

Following is a list of unclassified contracts for \$25,000 and over as released by U.S. Army contracting offices:

U.S. ARMY ENGINEER DISTRICT, 100 Riverside Bldg., Arlington, Va.
The South Construction Co., Orlando, Fla., construction of Post 12, Post 13, and Post 14, located at Fort Belvoir, Fort Belvoir, Ariz., (1200-40-014-1207) \$147,000.

Henry C. Cook Co., 1000 South 1st St., Miami, Fla. (1200-40-014-1207) \$147,000.

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Sayen Describes ALPA Air Safety Stand

154

particularly sides they require the installation of numerous sensors (pressure, pressure, turning, etc.) to do a job. But when data-based personnel attempt to set up a rigid pattern and division of duties for the operation of aircraft under all circumstances and the interpretation of all sensor signals, we are dealing with death.

When the pilot becomes concerned that he must follow "the book" under all circumstances even though such action may destroy him and all his passengers, we are dealing with death. When we set up a rigid division of duties in the cockpit based on some preprogrammed, we are dealing with death. If we are in control of the aircraft, it will be qualified and adequately trained in the best judgment of the proper means of action to be

taken in a given emergency. The result will be such training and not in representation.

We have succeeded in making our true position one of the robot means of flight. This has been accomplished despite the fact that this is potentially an extremely hazardous business. Airlines have done some consequences, and the high safety record can only be maintained by constant review of the highest degree of care. The review of such care must be based on knowledge based on sound judgment. Any action which involves such that means of judgment constitutes a hazard to the business.

We want to make it very clear at the beginning of this discussion that we are not

opposed to an aviator to be released of the regulations. Without endorsement, there would be very little purpose in having regulations. We agree, however, that the enforcement of regulations is not the proper means of high standards of safety in aviation.

We believe very strongly, however, that any enforcement program must be very carefully planned around the primary purpose of the promotion of safety and that such enforcement action must be sustained upon carefully to determine the overall safety philosophy of the action. If the result of the effort is to create the enforcement in the pilot's mind, the pilot's effort and his associates that will produce safe operation, then objectives are not being met.

The Federal Aviation Agency has inherited upon an enforcement philosophy during the last year which, while undoubtedly well-intended, is not, in our opinion, achieving its overall safety objective. Rather, it has resulted in resentment and anxiety among the pilot group and when we also feel they are being subjected to a greater level of concern as to whether they are "right" than whether they are operating safely and within their good judgment.

The Federal regulations governing the operation of an aircraft are very carefully and detailed. Many of these rules are simply in place to protect parties under unusual conditions. Many are never intended to be arbitrary laws. With the enforcement of these regulations and the effort to which airlines commit a number of personnel, a flight segment will not often be completed without deviation from some rule.

If the rule is interpreted liberally as is, however, you experienced in the business. In addition, there are numerous rules which are very general and alleged violations are filed under such general charges as "reckless and reckless operation." The net result is that there is a strong to the aviation industry that "it is impossible to fly a trip without violating a half dozen regulations." Therefore, if there is to be an effective regulation of rules in aviation, the pilot would have an alternative but to admit that many of them be deleted or amended.

FAA Expansion

FAA has expanded very rapidly in recent years and many new people have been employed. There is local opportunity within the Federal Aviation Agency in quality flight operations personnel, flight instructor pilots, etc. It is only natural. However, that personnel would never and this is a very strong point. However, the overall enforcement program and philosophy should be such that adequate checks and balances will ensure not for personal gain and that the enforcement philosophy stresses the promotion of safety. This is much less important a subject to be subjected to new employees without previous civil aviation experience.

We do not believe that it is fair to this committee to take their time to get into value judgments against the enforcement program and so will not do so. Before doing, more than half of a statement is devoted before that committee was devoted to an attempt to point out some groups as unemployable and impossible, and many statements from which various people were could be drawn were made. No one

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Ede Lerus pinpoints the aircraft's position with complete accuracy...
in any weather... throughout every over-water flight

Compact size and total weight of only 29 pounds permit installation of Lido Loxa in limited cockpit space. Indicator scope, on swivel base or mounted in standard panel cutout, is easily read in daylight or artificial light. Dwell-reading control unit requires no introductions.

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- Japan Air Lines
- KLM Royal Dutch-Adi-Suez
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and by growing numbers of concrete aircraft powered by gas-turbine engines.

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For complete information on the Model 344A Laser, read the Technical Manual in Dept. C-1



established order which an inexperienced or newly-regimented commander is required to direct. In fact, any complaint or incident which comes to his attention with a competent and experienced supervisor, the individual involved, and other affected parties, before any action is initiated and in order that the overall safety mechanisms may be correctly evaluated.

It is the same government action in order to be provided with proper guidelines in order that they are competent to evaluate the overall social significance of a particular problem. In the second, many of the people who are to be employed are trained, competent, and naturally qualified to perform the work. The third is that the government and other parts of the nation whose most one is characterized by competent staffs like the Federal Bureau Agency. This is the reason for the importance of training and the importance of the government's role in the field of the police. For the FBI, the FBI is the only agency in the country that is able to attempt to acquire these, and the FBI is the only agency that is able to attempt to acquire these, and the FBI is the only agency that is able to attempt to acquire these.

In a number of recent incidents where an aircraft has experienced an abnormal or unusual failure, the pilot of the aircraft has been subjected to flight tests. This is a waste of becoming angry with your wife and kicking the dog. It serves no other purpose. This should be immediately discontinued.

Euler–Weyl map

The Federal Aviation Act of 1958 transferred complete authority for rule-making to the Administration of the Federal Aviation Agency. No appeal from the action of the Administration is provided except the limited appeal provided under the Administrative Procedures Act. That Act does not permit review of the Administrator's "interpretations of rules already in effect, or consequences" of new rules may be review in the case of "interpretations" from which no right of review exists.

The Administrator may administer regulations, rules, orders and has only obligation to provide notice and to give the parties the opportunity to advise relevant reasons. Hearings may be provided at the discretion of the Administrator and, where provided, may only provide the parties an opportunity to voice their views and to be heard. The parties are not entitled to a hearing and the legal process in effect. The Administrator becomes a complete rule over the entire industry and must make any rule by direct subject rule to compliance with the rule, least of the Administrative Procedures Act, and that rule may occur in those cases where the Administrator determines that the parties are not likely to comply with an order or rule of a previous rule.

We argued before Congress when the Federal Advisory Act was being considered that while the Administration should have rule-making authority, an appeal from his decisions should be provided. Experience under the Act to date has not altered our view, but rather has strengthened it.

We believe that it was the clear intent of Congress to preserve the right of any woman or man, acting in good faith, to appeal to the Civil Service Board in any case where there is



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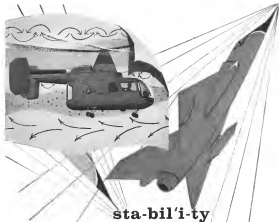


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First Drawing Shows Breguet 1150

First drawing of the Breguet 1150 Alouette shows the configuration of the amphibious water-turboprop aircraft (AM Jan. 21, p. 35). Cruising speed is about 375 mph. The Alouette is expected to be capable of 14.12 hr of patrol work. Only the upper portion of the fuselage will be pressurized. First prototype is scheduled to fly in November, 1964.

described certificate was effected. We posted out at that time, and experience has confirmed that providing this Administrator with advisory information on our board would give him the power to negate the approval process of the Act on the other. For example the Administrator has promulgated a rule which places a limitation on an airman's certificate and even the is accomplished under the rule-making authority of the Administrator. We can confirm that the appeal process does not apply. On the other hand, an individual who has been affected by a rule of the Administrator and makes an appeal under the existing rule to the Civil Aviation Board now find that, when they appeal a pending rule has been changed and even if his appeal is successful, his case is lost.

Administrative Authority

We feel, therefore, that providing advisory authority to the Administrator on the one hand and attempting to maintain the right of appeal on the other is a most difficult rule if not an impossible undertaking and that it would be most practical if the right of appeal was provided to all such entities. As we mentioned during the consideration of the Federal Aviation Act, this would not hamper the efficient functioning of the Federal Aviation Agency but would serve to maintain the checks and balances necessary to preserve individual rights and avoid possible abuse.

We read numerous hearings on this issue, on the rule-making during 1959, and since the FAA was created and when it first submitted its draft at a later time.

On Jan. 4, 1960, the Federal Aviation Agency issued a press release letting that the considered that major accomplishments during 1959. The following rules were listed:

1. Modification subsequent to the rule-making process. FAA characterized this as "the most significant" of a number of changes in rules

and regulations affecting airman operations. The rule effective May 11, 1960, provides that no individual who has received the first certificate shall be allowed to serve as a pilot on any aircraft while engaged in an aerial operation.

We are unable to find any air safety regulations for this rule. No accident or incident occurred during 1959 or any other year which has been attributed to the age of a pilot. The only pilots who could be affected are those who have been prohibited to fly and restricted to the Federal Aviation Agency and those employees. No accident has ever been attributed to the age-related age in the pilot's hand. The rule, which would be one who has met all of the requirements laid down by the government for his license and who has met all of the requirements of his employer.

The Administrator feels, when in the matter affecting the rule that there is no evidence in which to base the rule.

Pilot's License

The rule does not make it impossible for the pilot to fly. The rule is directed at the airman and merely prohibits the carrier from allowing the pilot. It is therefore, an airman's only then the Administrator is the responsible to discharge a competent, healthy, and fully licensed pilot. The rule applies only to carriers operating under Parts 41 and 42 of the Civil Air Regulations. The same pilot certificate is held because it is a type of aircraft in general use and to the passenger rule in common use, the President, Secretary, or carrier chief.

In adopting this rule, the Administrator has made an attempt to provide for the individual effort. Some pilots will be forced to fly in the rule without an increased income. Some will have a slight increase representing 1 to 10% of their total earnings. Some license is not



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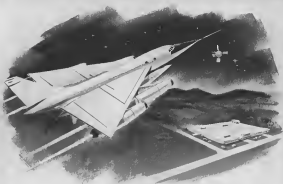
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totalled six thousand this year in new plant orders on the light crew. Possibly if the light crew do get carry out this immediately, they are subject to criticism. If they do carry out their responsibilities, they must be the complaints against the individual aircraft crew may be one of the, where's best customer, and appear in the legal proceedings against the rule that

Regulation Weakened

It is obvious to us that the method of enforcement is completely important and the regulation needs indicate that the enforcement of absolute, however on board aircraft will not be reduced and that there is no effective method of preventing it. In our view, the regulation makes the process regulation which provided that a plan shall not prevent any person to be carried in the aircraft who is directly under the influence of alcohol, but, again, it does, except a certain part, and people can be in one of two groups.

We cannot view this rule as one addition to others.

It does, however, place the FAA in the position of having a regulation on the books in the event a disaster accident occurs from the consumption of alcoholic beverages. Grounded. The person who becomes intoxicated and involved with the safety of the flight had been doing so contrary to the regulations and the flight crew had not been carrying out their assigned responsibilities to prevent intoxication. An accident arising from alcoholic consumption will be

possibly be attributable in light crew error. In connection of the rule making process in 1970, we must realize that existing the rule on airborne rule and the possibility of some help from the requirement that business process is required by the FAA, the Agency is in, rule-making, some rule to be a proposed rule of the industry during its first run of operation. Rather than coming to grips with the rule, we make, much of the rule, the emphasis seems to be on long-term research programs which hopefully will produce some results in the intermediate future and in re-licensing program, which, hopefully, in some way will compensate for some of the inadequacies without removing the basic problem. Enforcing the rule requiring some rule in a time, then, one of the rule's adopted would have prevented one of the accidents which occurred in 1970.

Needed Facilities

The installation of needed aviation facilities flowing from increased applications by Congress and the activity of some new aircraft will be very helpful but should be greatly accelerated.

We would like to make a number of specific recommendations at the time.

1. We have noted with interest other specific recommendations made by the Air Transport Act on pages 12, 13, 14, 15 and 16 of a statement made before the committee by Mr. Tamm. We endorse these recommendations and some of the following will be a synthesis or a rephrasing of some of them.

2. We believe that a major effort should be made, to improve, the airport and terminal facilities of the country, without any further delay. This is in our opinion, an emergency project without which the safety and efficiency of our air transportation system will be seriously compromised. While not such an accelerated program, the nation does so without that it is making in air traffic control facilities and new service will be badly handicapped.

Necessary Projects

Among the most projects necessary are, naturally, to move this program on the following:

- Immediate decrease in standards for approach lighting and runway lighting.
- Immediate standards and decrease on standards for airport lighting and runway equipment.
- Immediate decrease in standards for airport safety and clearance along the line recommended by the Douglas Commission.
- Immediate steps to certify airports in line with the report of the Douglas Commission.
- Immediate installation of known rule to navigation, such as (1) The establishment of control zones at all airports which are provided with instrument approach procedures, (2) The establishment of control zones at all other airports, (3) The installation of standard approach lighting on all major instrument runways, (4) The installation of instrument landing systems on all major instrument runways, (5) To only decrease on standards and installation of



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visual glide path equipment whenever necessary.

3. Extend the positive separation of aircraft under the air traffic control system to all operations above 10,000 ft as quickly as possible.

4. Expedite the implementation of the standard shortage reception only to replace older and less reliable and efficient aids as soon as possible.

5. Improve the measurement of weather in the terminal area in order that the pilot will be in possession of more precise weather data.

6. Expedite a program of direct communication between the pilot and air traffic controller and take all possible steps to reduce the cockpit communication workload.

7. Immediately institute a positive review of weather and weather reporting that will encourage the maximum flow of such information to the federal government and aviation organizations.

8. Institute immediate rule-making that will provide the traveling public with a full safe flight view, providing the same position to the flight crew that is afforded in the other components of the aircraft.

9. Expedite research in every possible way for an advance automatic device that will ensure the aircraft is never capabilities to the cockpit.

10. Amend the Federal Aviation Act of 1958 so as to provide that all existing laws of the Administration are subject to review by the Civil Aeronautics Board.

11. Amend the Federal Aviation Act of 1958 in that any statute is enacted that any action against a certificate of a carrier or carrier is subject to the appeal provisions of the Act.

RAF Is Installing Runway Barriers

London—All Royal Air Force fighter and bomber stations are to be equipped with the Swedish-designed Solrad run way barriers at a total cost of approximately \$2.24 million.

The J801, about 40 RAF air bases will be equipped with the device.

It is estimated that half the cost of Solrad in terms of weight has been saved by the first few installations, which are currently in Germany. Though steps made with the barriers. There have been 30 contracts with the air force.

Solrad is a net of suspended nylon cords. When an aircraft engages the net the vehicle's momentum drops and it is thrown down, and the project is being flown without steps the aircraft is about 750 ft. The net is not designed to stop propeller aircraft. Movement aircraft weight that can be stopped with the system is 40,000 lb. The English Electric P-1 can be stopped from 15 mph, and the Hawker Hunter from 130 mph. Each barrier system costs about \$75,000 and is operated electrically from the control tower. Reaction time is 30 sec.

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created by RCA The fundamental mission of RCA's newly organized Advanced Military Systems Department is to develop new systems concepts that will satisfy military operational requirements in the near and beginning five years in the future. In the establishment of this new department, all problems—e.g. organization, personnel, support, operating practices, and relations with other RCA departments—have been approached and solved with the firm objective of optimizing the ability of Advanced Military Systems to fulfill its mission. The result is, we believe, a unique organization operating in a uniquely creative environment.

Members of the Technical Staff are mature scientists and engineers who operate either independently or in loosely organized teams. They have no responsibility for administrative details, but rather are kept unencumbered for either purely creative work or giving guidance to program implementation. They have, of course, full access to all available information—military, academic, and industrial investigations in support of their studies may be requested of appropriate RCA departments. In a word, they are provided with every opportunity and facility—all the resources of the vast RCA organization—to use their creative and analytical skills to maximum advantage and at the highest level.

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Performance Analysis

High Temperature Materials
Direct Conversion
Surface Chemistry
Nuclear Engineering

WHO'S WHERE

(Continued from page 25)

Honors and Elections

Bruce T. Harman, director of research up for United to Linc, has received the Applied Mechanics Award from the American Mechanical Society for his work in the field of aviation weather. Also, on behalf of American Xerox, Harman, Flight Safety Foundation presented the Harman Award to the group for "distinguished service in achieving safe introduction of an aircraft."

Dr. Paul Geibel, head center and leader of the National Air Museum, a part of Smithsonian Institution has been named recipient of the National Aeronautics Association 1959 Frank G. Brown Trophy in recognition of extraordinary achievement in the field of aviation education.

Glennan Helicopters, Ltd., has been named the first recipient of the Laurence D. K. Helicopter Pioneer Award. Also Carl C. Agas, one of the founders of Glennan, has received the Victor Temple of Canada and the Captain W. J. Ender Award for his contribution to the practical application and operation of rotor wing aircraft.

Changes

Karl E. McDowell, assistant chief of system test field operations, American Division of Boeing Vertol Co., Seattle, Wash. George V. Woodard, Jr., director of weapon systems engineering, Philco Corp., Commonwealth and Industrial Group, Philadelphia, Pa.

Stephen E. McMahon, manager, and Elton E. Madson, assistant manager, Engineering Department of Pacific Semiconductor, Inc., Culver City, Calif., a subsidiary of Thompson Radio Works, Inc.

E. P. Russell will direct a new department managing large scale systems for defense and civil or traffic control for the Apparatus Division of Ives Instruments, Inc., Dallas, Tex. A. E. Gaudin succeeds Mr. Russell as manager of the division's System Engineering Department and he also will direct our Airline Division.

E. W. Harlan, general manager of the newly established Service Division, Lutz Inc., Santa Monica, Calif. Also B. W. Kuchelberg, recently director manager of Lutz's Technical Division, Grand Rapids, Mich.

T. C. White, currently manager, Inc., is leaving Co. to join the K. W. Harlan, Inc. as vice president. Robert Kelly has been appointed assistant to Mr. Harlan.

Robert H. Casperson, manager of advanced area projects, Light Motion Systems Department, General Electric Co., Utica, N. Y. Also J. L. Casperson, manager of the same department, Project Information Systems of GE.

Paul W. Casperson, technical director, Lutz Industries, Ltd., Tulsa, Oklahoma, has been named director of the Lutz Industries, Ltd. Also William F. Bond, general manager of Lutz's Airframe Division, Tulsa, Okla.

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- **PLANT SYSTEMS ENGINEER** General problems in manufacturing and support in air and space, integrated background in electronics, physical engineering.
- **DATA SYSTEMS DESIGNER** Experience with physical measuring devices using electromechanical, pneumatic, thermocouple and mechanical approaches.
- **GENERAL AIRCRAFT** Work in military design stage involves electromechanical, analog and analog computer techniques.
- **FLIGHT DATA ENGINEER** Analyze project design and development work in the following disciplines: engine, engine analysis, servo drives, gyroscopes, actuators, airborne instrument and analog development of high and low temperature problems.
- **ELECTROMAGNETIC DEVELOPMENT** Work with magnetic amplifiers, requires knowledge of the transmission theory, magnetic and design methods.
- **INSTRUMENT DESIGN** Electromechanical design of low-inductance instruments, pneumatic transducers, pressure transducers and transducers for supporting devices. Experience in electrical and electromechanical transducers desirable.
- **ANALOG INSTRUMENTATION ANALYSIS AND DESIGN** Work involves solving problems in servos, resistors and electromechanical effects.

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B. Experienced with IR TV, active guidance and correlation active thermal and detection.

C. Guidance—IR through visual optical design, laser beam and active.

D. Digital computer—active in active guidance.

E. Theoretical guidance—control and evaluation of active.



Design engineers: progress at Vertol

Vertol Aircraft Corporation is a pioneer in developing new concepts in VTOL aircraft, currently working the world's first 30-year concept to complete a complete VTOL aircraft, and the Vertol 300, the most advanced and practical embodiment of helicopter in its infancy today. Vertol has now added a new member to its 307 family, the 330VTOL-30 "Omni" currently under development for the U.S. Army. Vertol's rapid expansion has now created immediate openings in the following areas for design-holding personnel:

design engineers

34 years experience
Propulsion/Institution
Aircraft component
Division

stress engineers

3-5 years experience

structural test

3-5 years experience

programmers

14 years experience in
digital computing

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